

FLYING FASTER THAN A BULLET

POPULAR MECHANICS



MAGAZINE

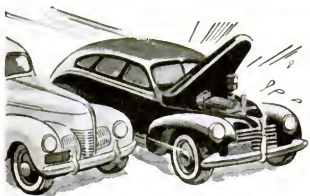
WRITTEN SO YOU CAN UNDERSTAND IT

JULY
25 CENTS
30c IN CANADA

SEE PAGE 54



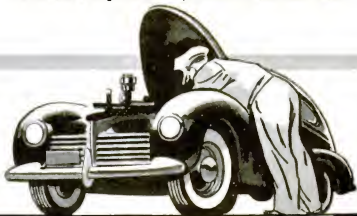
"I JUST HAD A HOOD-RAISING EXPERIENCE!"



"It was one of those emergencies where power means safety. We were passing a car on the highway when another car turned in from the left. My driver 'gave me the gas,' but I just didn't have any pep.

"Under the strain, my worn-out spark plug wires 'shorted' to a ground, robbing the spark plugs. If the driver we were passing hadn't slammed on his brakes and pulled over, it would have been bad.

"Next thing I knew, we were in a Packard Certified Re-Wiring station, and my hood was up. The mechanic replaced the old wires with new Packard cables. Then he checked *all* the electrical circuits. No more failures like that for me!"



FOR YOUR OWN *Safety* GET A PACKARD CERTIFIED RE-WIRING CHECK-UP



It doesn't take long or cost much to have a trained Certified Re-Wiring mechanic go over your car and replace defective, worn-out cables. If the spark plug wires are "leaking," a new set of

Packard ignition cables will restore pep and power. If his accurate checking instruments show "bottlenecks" in the starting, primary ignition, lighting or accessory circuits, he will make all the necessary replacements with Packard cables of the right gauge.

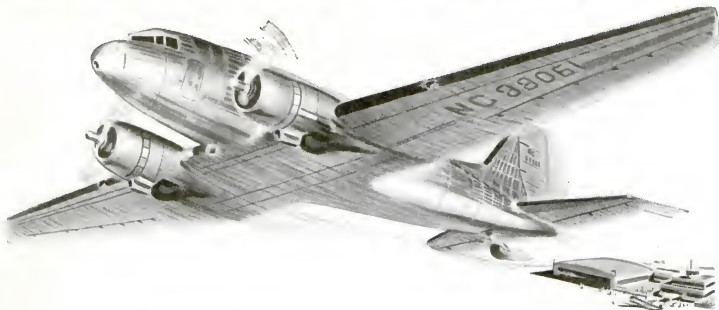
A Packard Certified Re-Wiring check-up is an important safety measure. It's a safeguard against possible fires from bad connections, and often prevents costly repairs to other electrical units.

If your regular dealer doesn't offer Packard Certified Re-Wiring Service, have him get in touch with his Packard jobber. Packard Electric Division, General Motors Corporation, Warren, O.

Packard
REG. U.S. PAT. OFF.
TRADE MARK

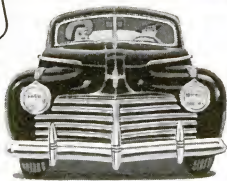
THE STANDARD WIRING EQUIPMENT OF THE AUTOMOTIVE INDUSTRY

Takes off like a transport plane!



The Speedometer tells the Story of

**CHRYSLER
FLUID DRIVE
PICKUP!**



THE *Fluid Drive* Chrysler takes off with the smooth, steady power-pull of a transport plane. No jerks...no heave-and-rest tugging...just a giant surge of power that's smooth as oil, because it's a drive through oil!

Just keep your eye on the speedometer as you tread the accelerator of a *Fluid Drive* Chrysler.

Watch that needle move swiftly...steadily...smoothly.

Without touching the gear shift lever...always in high-gear position...you move

in a twinkling, without jolts or jerks, to the head of the traffic line!

Action so smooth you don't realize how swift it is unless you watch the needle. You get away like a transport plane...and like a plane with variable-pitch propellers, you cruise on a small fraction of your total horsepower...a great contribution to economy!

Try *Fluid Driving* today at the nearest Chrysler dealer's . . . and don't forget to watch the speedometer climb!

See the last word in Station Wagons... Chrysler Town & Country Car

★ Tune in Major Bowes, CBS, Thurs., 9-10 P.M., E.D.S.T.

**BE MODERN WITH FLUID DRIVE
AND VACUMATIC TRANSMISSION—**

Buy Chrysler!

WHY SPARK PLUGS NEED CLEANING



WHITE
Oxide Coating
Cleaning is possible

Oxide coating,—a residue of combustion, which collects on spark plug insulators,—is an electrical conductor when hot. When the engine is pulling hard, or turning at high speed, the temperature of the coating is high, and its conductivity at a peak.

Under these conditions, the spark plugs misfire because the oxide coating intermittently short circuits the current, and the fuel charges in the cylinder are not fired. The misfiring eliminates the heat source, and the temperature drops,—the oxide cools,—and the plug starts firing again.

"Jack-Knife Cleaning" Won't Do
Oxide coating (see pictures 1 and 2) cannot be scraped away. It adheres too tightly to the spark plug insulator. Yet, if not removed at 4,000 mile intervals, it can result in a loss of power



FUSED
Oxide Coating
Cleaning still possible

as great as 21%, and a gas waste as high as one gallon in ten.

Registered AC Spark Plug Cleaning Stations (there are 60,000 of them) were established and equipped by AC because of ox-



BLISTERED
Oxide Coating
Too late for cleaning

when plugs are too blistered, as in picture 3, or too worn for further good performance. Usually this is around the 10,000 mile mark. Such plugs should be replaced to be sure of peak performance, best fuel mileage, and easy starting.



ide coating. They use a special AC cleaning machine which completely removes this coating in a few seconds. At 5¢ a plug, their service is a real economy.

Remedy for Worn or Blistered Plugs
Of course, there comes a time

The
QUALITY
Spark Plug



More AC's are used as standard factory equipment than any other make of spark plugs

AC SPARK PLUG DIVISION • General Motors Corporation • FLINT, MICHIGAN

Popular Mechanics Magazine

Registered in U. S. Patent Office and Canada

H. H. WINDSOR, Founder

H. H. WINDSOR, Jr., Editor and Publisher

July, 1941

Vol. 76, No. 1

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Meeting the Submarine Menace

ONLY the submarine can beat the submarine, says Simon Lake. The man who invented the even-keel submarine back in 1897 thinks building surface ships to aid Britain is like adding coal to a fire, for in the long run submarines will always win over surface craft. Instead, he proposes in a signed article written for our August issue the construction of giant cargo-carrying submarines. Not mere 600-tonners like the "Deutschland" that eluded the British blockade to reach America in 1916, but 13,000-ton submersible freighters. Don't miss his story.

The Age of Packaged Power

FROM Chicago to New York a Stratoliner races in less than three hours. A Diesel "tank" prowls Antarctica, a 13,900-ton motorship goes to sea, a gas engine powers a Dakota farm. Numbed by marvels, we take for granted the internal-combustion engine. Changes in address must be reported to us immediately to eliminate delay. Entered as Second Class Matter, Sept. 15, 1905, at the Post Office at Chicago, Illinois, under Act of March 3, 1879. Entered as Second Class Matter at Post Office Dept. Canada.

Next Month

TWENTY years ago they said the oil famine would arrive by 1941. It is still a third of a century ahead of us, yet today engineers can extract only a third of the oil in a pool. If another third could be recovered, our reserves would be doubled. Perhaps this will come, with the new technique of horizontal drilling, which lets oil flow by gravity from its pool. The story of this development is told in "More Oil from the Earth" with eight Coloroto pages, in August.

Our Secret Weapons

PLENTY of crackpot ideas about war-winning weapons are offered our defense authorities. Tips about 100-mile death rays and "clouds" that explode on contact with a bomber. But there are valuable suggestions by the score, and scientists are culling them and developing their own ideas for guarding the U. S. A. from attack. A new explosive made of steam, air and natural gas is one secret weapon of which you are given an inkling in a feature next month.

Fitting Men to Jobs

YOU might have been a great violinist, but you're shoveling coal on a locomotive. Or you're unhappy as a lawyer while latent architectural ability lies unrealized. Well, more than a million persons are finding the right jobs this year through industrial aptitude tests. "Fitting the Man to the Job," an August article, is worth your while to read.

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NOW WHAT HAVE YOU GOT TO SAY!



1. I agree that Dave was plenty justified in boasting about his new car. "Man! What zip!" he said. "What smoothness!"



2. I told him: "If you take my advice you'll protect it with Pyroil. You know sludge, gum, carbon and acid-corrosion can wreck a new engine!"



3. "Boosh!" Dave says. "Why this engine's new. It's got a lubrication system, what I mean! It doesn't need anything extra to protect it. They build engines nowadays to run under severe conditions—high speed, hard driving. Today's engines are built to stand up!



4. Well, sir, that was only six months ago. Today I passed poor, crestfallen Dave as they were towing him in. Later on he told me: "Everything happens to me! A broken bearing—wrecked by acid-corrosion!" "Dave," I said, "Pyroil could have saved you this. Pyroil would have protected that fine new engine against justsuch damage breakdown!"

Yes, Pyroil keeps a clean engine clean. That's why it is so excellent for new cars. Pyroil is b-a-l-a-n-c-e-d to protect engines, new and old, against the inroads of contaminations like sludge, gum, hard carbon and acid-corrosion. At the same time it maintains "silky" responsiveness; improves performance where performance lags.

Ask your service station or garage salesman to "add a little Pyroil" to the gas tank and the crankcase of your car, today. Only a few ounces needed, at only a few pennies cost. Enjoy the difference! Manufactured and Guaranteed by Pyroil Company, W. V. Kidder, Founder, 57 Pyroil Bldg., LaCrosse, Wisconsin, U. S. A.



ADD
MERELY
OUNCES TO
GAS TANK &
CRANKCASE

DISTRIBUTORS:
CHECK AND MAIL
COUPON FOR FRAN-
CHISE FACTS.

PYROIL COMPANY,
57 Pyroil Bldg., LaCrosse, Wisconsin, U.S.A.
I'd like to know why and how Pyroil protects new and old cars against acid-corrosion and other contaminations. Please send Free circular, "What Motor Car Manufacturers say."
☐ Send details of your plan for Distributors.

Name.....
Address.....
City..... State.....

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Including names and addresses of manufacturers or distributors of commercially available products

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YOU CAN FEEL THE QUALITY OF A GOOD SUIT...



YOU CAN SEE THE STERLING MARK ON SOLID SILVER...



AND WHEN YOU STOP TO BUY GASOLINE, THIS EMBLEM TELLS YOU WHICH PUMP CONTAINS THE BEST

*THE BETTER THE GAS,
THE BETTER YOUR CAR*

THE ETHYL EMBLEM on a gasoline pump stands for extra quality in anti-knock (octane number) and all-round value. Samples are double-checked by your oil company and the Ethyl laboratories.

In your car, "Ethyl" means a cooler-running engine in summer; a quicker-starting engine in winter; extra power and smoothness all year. When you stop for gasoline, the Ethyl emblem tells you which pump contains the best. ETHYL GASOLINE CORPORATION, NEW YORK

This One



FAT5-DON-URJ2

JULY, 1941

5A

Tough

but oh so Gentle



TOUGH on OIL-PUMPING • GENTLE on CYLINDER WALLS

● There's just nothing you can do about worn-out piston rings except replace them. And the sooner the better.

Worn piston rings cause oil-pumping—that means wasted oil. But even more important, worn piston rings often signal rapid cylinder wear—and that leads to excessive repair bills.

At the first sign of oil-pumping replace your worn rings with Hastings Steel-Vent Piston Rings. They stop oil-pumping and check cylinder wear. Any good mechanic can install them—quickly and economically.

Buying a used car? Ask the dealer if it's Steel-Vent Reconditioned. It's a better buy if it is.

HASTINGS MANUFACTURING CO., HASTINGS, MICHIGAN
Toronto and Winnipeg

HASTINGS

STEEL-VENT PISTON RINGS

Stop Oil-Pumping.

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228 Kha Balla
POPULAR MECHANICS

Have you come to this point?



Once in almost every man's life there comes the time when he realizes, with the suddenness of a lightning flash, that he isn't getting anywhere . . . that, while time is flying, he is standing still, in a business way . . . with no promotions and a stationary income . . . and that all the while he is growing older, and older, and OLDER.

He may even realize that his failure is due to his lack of special ability, but—if he is like all too many men, he does nothing about it, accepts the whole picture as inevitable, perhaps feels a bit bitter about it, and goes on down.

But—if he has the right metal in him—he'll do what thousands of others have done in the last thirty-three years—men who found themselves going round and round in a back eddy—he'll begin at once to qualify himself for a better position (and for still bigger and better positions) by getting special training in his spare time at home.

That's the LaSalle way . . .

. . . learn while you earn

and almost inevitably, you'll get more and more money because you'll be worth more and more.

Dramatic life stories . . . stranger, many of them, than fiction . . . are told in thousands of letters in our files—of men climbing from the

ranks of common labor to financial independence or professional ranking . . . of thousands lifting themselves from dead-end jobs of hopelessness to the path of rapid promotion and bigger money.

Right now . . . today . . . this very minute . . . there are thousands of well-paying openings for the men qualified to fill them; for there is a definite shortage of highly-trained men—the kind that know what to do and how and when to do it.

During the next ten years, *this shortage will be even greater*—due to rearmament, industrial expansion, and the absence of many men in military service. So—

NOW is the time for YOU to act . . . to say good-bye forever to discouragement, to a fixed low income, to your many money disappointments . . . by checking and mailing the coupon below. What it brings to you will cost you only a postage stamp, but it has been worth a fortune to thousands and CAN be to YOU.

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Please send me your interesting 48-page book on the field indicated, and outline of low cost LaSalle plan—all entirely free.

Tell us which of the following programs of home-study training interests you most:

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| <input type="checkbox"/> Higher Accountancy | <input type="checkbox"/> Law—LL. B. Degree | <input type="checkbox"/> Advanced Accountants |
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Name Present Position
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Address Age

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Dept. P, Milwaukee, Wisconsin.
Send FREE copy of big 24-page "Enthusiast" magazine filled with thrilling motorcycle pictures and stories. Also literature on the latest Harley-Davidsons. Stamp is enclosed for mailing cost.

Name

Address

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**I can't hire
the man
who says:**

**"I CAN DO
ANYTHING!"**

"There's no room in my business—or in most others—for the jack-of-all-trades. What we're looking for is men who are trained to do one thing, and do it well!"

"That's why we pay special attention to applicants who are I.C.S. graduates. We know they're ambitious, intelligent, able to concentrate—and we know that the International Correspondence

Schools provide their students with sound, practical, modern training!"

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Without cost or obligation, please send me a copy of your booklet, "Who Wins and Why," and full particulars about the course before which I have marked X:



TECHNICAL AND INDUSTRIAL COURSES

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| | | <input type="checkbox"/> Locomotive Engineer | <input type="checkbox"/> Radio Operating | <input type="checkbox"/> Textile Designing | <input type="checkbox"/> Toolmaking |
| | | <input type="checkbox"/> Machinist | <input type="checkbox"/> Radio Servicing | <input type="checkbox"/> Welding, Electric and Gas | |
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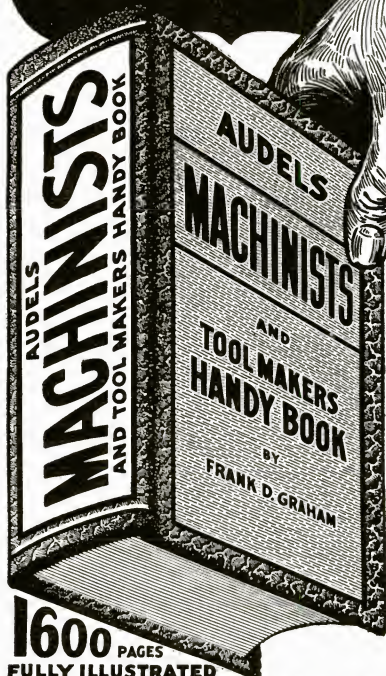
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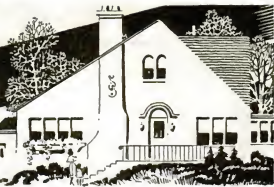
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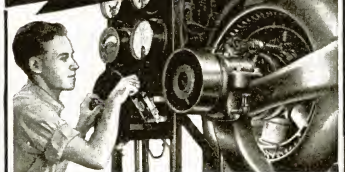
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WANTED. Collections, accumulations. Send description. Leslie Stamp Company, Haverhill, Mass.

SENSATIONAL Combination offer! Big packet 105 different including Iceland, Manchukuo, Ecuador (American flag in air), Ecuador, airmail, Poland (commemoratives, triangle stamp, 44 United States; complete set United States telegraphs, cancelled British Colonies, 34 United States, including Gwalior, Hyderabad, Burma (new country) jubilee and coronations. Scarce Far Eastern republic cataloging 50c. Big illustrated list of other bargains. Only catalog price over \$3.00! All for only 5c to approval applicants! World-Wide Stamp Company, Department 860-N, Camden, New York.

UNITED STATES on approval. Gordon Davidson, Box 568, Manchester, N. H.

FRANCE! Fourteen large 1931-9 commemoratives 25c. Approvals? Dufort's, 4402 Chateaubriand, Montreal, Canada.

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300 ALL Different stamps—Strong in pictorials from occupied countries—10c—while they last—to approval applicants only. Official Stamp Company, Department 7, Fairlawn, Jersey.

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250 VARIOUS 10c: Genuine Saxony 15c; Roman states 25c. Ajax, Box 8009, Kansas City, Mo.

ALBANIA 200-209 (Scarc) 8c with approval. Turner, 3024 Vicksburg, Detroit, Michigan.

FREE! 20 Different commemoratives. Postage 3c. Penny approvals that satisfy. Doyle, Box 41E, Bartonton, Ohio.

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1941 STAMP Catalogue free. Lists British, American, United States, foreign. Free. Gray Stamp, Dept. PM, Toronto, Canada.

CHINA Famine relief stamps 5c, approvals. Avery, Morton Street, Andover, Mass.

LOW Priced U. S. approvals. Postage paid both ways. Kaiser Stamp Co., 302 Hurley, St. Paul, Minn.

MINT Sets—China \$1.00 and \$2.00 (No. J87-788) 25c. Manchukuo—four 1941, 5c. Costa Rica, 1937 four triangles 7c, with approvals. Pkeigwin Company, Vineyard, N. Y.

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\$2.00 HONG KONG Stamp only 3c to approval buyers. LeDuc, Saint Petersburg, Florida.

WEEKLY Stamp magazine, thirteen weeks, 10c. Stamp Journal, Kalamazoo, Mich.

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SCARCE Diamond airmail! Wonderful packet of different from strange countries. British colonies, Haiti, Tasmalia, pictorials, etc. 5c with approvals. Reliable, 95 Nassau St., New York City.

\$2.00 INTRODUCTORY Packet 3c. Request approvals. Quality Stamps, Englewood, Colorado.

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ROLL Developed and 4x8 oversize glossy Velox prints 8 exposures, 25c; 12 exposure 35c; 16 exposure 50c. Coudie Photo Service, Dept. M, 1318 W. Columbia Ave., Philadelphia, Penna.

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18 SPARKLING Lifetone prints. 3 Hollywood enlargement coupon. (Tovary frames from roll developed.) 25c. 21 reprints 25c; 100—\$1.00. Overnight Studio, 55 Cedar, Albany, Wis.

VELOX De-ckle-edge reprints—100, \$1.00. Roll developed, 16 prints and one professional enlargement or one professional enlargement and one professional enlargement. Same-day service. Satisfaction guaranteed. Superior Finishers, Dept. 55, Monroe, Wis.

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GLAMOUR Girl films. Sample dime. Artcard, Hammond Bld., Hammond, Ind.

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PUBLISHERS Need new songs. Poems wanted. Five Star Music Masters, 687 Beacon Building, Boston.

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CHEMICALS Convert tin cans into steel cans in 10 min. Process and sample of solvent \$1.00. Harry D. Cater, 455 Washington St., Denver, Colo.

GRAPHITOL Oil. Make your own. "Graphitoll," 4357 Papineau, Montreal, Canada.

"LUMINOUS Paint" shines in dark. Easily made. 300 other formulas, plans—all 25c. Ideal Service, 3007F, Park Ridge, Ill.

MAIL Order opportunities. Details, magazine free. Bureau, 549 Studewood, Houston, Texas.

FIVER Collection of business plans, contains 127 tested plans and scores of formulas. Start own business; home, office. Particulars free. Julius Piver, Pratt Station, Post Office Box 23, Brooklyn, New York.

BE A notary public, make more money. Short course. Diploma awarded. Free booklet, National Notary Institute, B-108 North Dearborn, Chicago.

HANDY Men—Earn money home operating Community "Fix-It" Shop. Stafford, 108 Rawlins, Carbondale, Illinois.

INCREASE Your business, make more money. Your ad in this space will bring you wonderful results. Write for amazing proof. F. W. Johnson, Classified Advertising Manager, Room 303, 200 East Ontario Street, Chicago.

CHIPPING Glass signs. Folder free. Beverage, 160-22 P Locust, Jamaica, New York.

CASH in on the tremendous productive market by saving manufacturers, producers, etc., countless working hours. 10c. Machine Systems, Box 520, Chicago.

MAKE Your Own Flexible Molds. Stationary Art Goods, Novelties, Artificial Marble Flooring, Liquid Marble. Literature free. Kemico, Inc., Park Ridge, Ill.

AMAZING Lawn novelties. Airline cutters. Gasoline or electric. Dealers wanted. Rotary Mower Company, Omaha, Nebraska.

YOU'LL Like resilvering mirrors, tableware, making chipped glass nametags, signs. Write Sprinkle, Plater, 127, Marion, Indiana.

RUBBER Molds, slightly used, \$1.00 each, big selection. Guaranteed liquid rubber, \$1.95 quart, \$4.95 gallon with free instructions. Southern Service, 3303-A Jackson, N. Y.

FOUR All-Profits plans 25c. Detlaf, 3347 South May, Chicago.

MAIL Order business course shows you how to make money, spare or fulltime. Teach professional mail order technique—no penny-catching schemes. Free details. Nelson Company, 500 Sherman, Dept. 404-G, Chicago.

POPCORN Machines, caramelizer crispettes, choco. choc. potato chips. Long Eakins, 2035-G High St., Springfield, Ohio.

MANY inventors will be interested in our service. Information on subject of obtaining a patent and marketing an invention supplied without charge. Write us personally. McMorrow & Berman, Registered Patent Attorneys, 124-W Barrier Building, Washington, D. C.

WIN Prize contests—34 page book tells how. 15c. Ideal Service, 179PC, Park Ridge, Ill.

"MONEY By Mail," splendid (25c) magazine for mail order operators. Latest, fine money-makers. Full, spare time. Sample 10c. Elkay Publishers, Englewood, N. J.

FREE. Highways to Romance—For advertisers-opportunity seekers. Charlson, 5 Carpenter, Chicago.

300 tested plans and formulas 25c. Martin Teker, Sheridan, Montana.

YOUR Name on exclusive mailing lists. Receive profitable mail. 25c. Butler Menu Service, 12c Lexington Ave., New York.

127 CLEVER money making schemes. Write W. Merkle, Harrisville, Penna.

100 Ways To make money 25c. George Beach, Hanover, Mass.

MAKE Artistic, marble, glazed tiles, uncanny. Artiletops, plaques, floors, homes, novelties. Hard, fireproof, inexpensive, cement secrets. Brilliant tile and liquid rubber samples 3c. John A. Fay, 945 Grande Vista Avenue, Los Angeles, Calif.

START "Soap Factory" at home. No machinery. Amazing opportunity. Details free. Kemico, 1787F, Park Ridge, Ill.

LAWN Mower sharpener built cheaply. Blueprint, instructions \$1.00. Bullion's Hardware, East Syracuse, N. Y.

ENOUGH Goods sent prepaid for 25c to make \$1.00 quickly—easily. More later. Schetz, 98-M Branch, Sellersville, Penna.

INVESTIGATE—Amazing mail order opportunities! Literature free. Apostie's, 112-P Buck, Paulsboro, N. J.

\$50-\$100 WEEKLY Using sawdust. Stamp appreciated. Clement, 943 Arthur, Rochester, N. Y.

SOAPMAKING. Learn home. No machinery needed. Fosera, A-4545 Bartlett, Milwaukee.

METALLIZING Baby-shoes makes you money! Simple! Novel! Perpetual market. Small investment. Fine profits! Full particulars free. Novelty Metallizers, Box 933-M Church Street Annex, New York.

BIG Profits in vending, amusement, slot machines. Tremendous market. Simple, interesting work. Spare or full time. 76 page instructive magazine 10c. Automatic Age, 4416 Erie, Chicago.

SINCERE Strivers for mailorder success line up with most helpful organization. Free details. No postals. Nassau Company, Winston-Salem, North Carolina.

BELTS—Make 'em and make money! Big season ahead! We supply the sample. Sample 25c. Art Jui Leather, 400 Joseph Ave., Rochester, N. Y.

RUBBER Molds. Vulcanized. Won't shrink up last year's. Most inexpensive. Make illuminated yard markers, cement articles, artificial marble, plaster, plastics. Fine details. Write Vulcanized Rubber Mold Co., 2720 Washington St. Louis, Mo.

MEN! Women! Invest in security. Few dollars start profitable, fascinating full or spare time business. Get the world's finest merchandise vendors. Handbook giving all details. 25c. Northwestern, Morris, Illinois.

WORK Pleasure, profit, at home in business. Service, Box 233 M. Carnegie, Pa.

SIGNS And showcards easily and expertly painted with letter patterns. Many sizes and styles. Write for descriptive folder. John Rahn, A1330 Central Ave., Chicago.

OPPORTUNITIES Pointed out, use of non investment success plan \$1.00 per year in advance. Satisfaction or money back. Address Multiple, Box 716, Pine Bluff, Ark.

PROFITABLE Mail order business. Instructions, 25c. Matz Products, Reading, Pennsylvania.

CASH For butterflies, insects. See Sinclair display advertisement page 12A.

INCREASE Your earnings in a profitable business. Have all the tools and take care of. Become a foot correctionist. Few weeks home training prepares you to earn big money in revenue. No capital needed. Chiropraxy. Easy terms. No further capital needed, no goods to buy, no agency. Spencer System, 576 Back Bay, Boston, Mass.

TURN Tin cans into money. Instructions 25c. H. Chaney, 1130 E. 16th St., Jacksonville, Fla.

MAKE Money at home by mail. Write Empire Mail Service, Box 85, Jacksonville, Florida.

POPCORN Machines. Caramelcorn equipment, popping kettles. Northside Mfg. Indianapolis, Ind.

LIQUID Marble—Colorful, glazed! Mold, brush, spray! Composition floors, rubber-lastic molds. Particulars free. Marbleizing Service, Beardsville, Illinois.

OWN And operate a general appliance repair shop. Small capital establishes you in profitable steady repeat business. Complete, illustrated course enables mechanically inclined men to start a business. All phases of general appliance repairing, how to secure business, etc. Covered. Send for details. Write: Christy Supply Co., Dept. 105, 2835 N. Central Ave., Chicago.

PLASTEX Industries offers industrious men an opportunity to start a business of their own, manufacturing art goods, novelties, souvenirs, etc., in Plastex and marble imitation. Schematics, make \$1 articles. Rubber moulds furnished for speed production. Small investment brings good returns. Big chain store orders now being placed. Write for details. Be first mailed free. Plastex Industries, Dept. A, 1085 Washington Ave., New York.

STUDY And become a licensed practitioner of the new psychological religious conception called "Oneness" for health, happiness and prosperity for self and others. Home study course. Exclusive territory in your district now open. Be first! 7,000 word booklet free. Write "Oneness Society," Box 71, Stoneham, Mass.

MEN—Women, operate "Specialty Candy Factory" home, all or part time. Opportunity for steady income. (Over 324 year). Ragdale Candies, East Orange, N. J.

DOLLARS Quarters, daily. Instructions 25c. Jerome Barnes, 3011 Glasgow, Portsmouth, Virginia.

MAKE Money by mail in home or office. Free information. Seymour Service, Box 266, So. Norwalk, Conn.

MAKE Money sharpening safety razor blades at home. Magic RazorRoll outfit—\$1.00. Write, Olendorf, 228 N. LaSalle, Chicago.

OPPORTUNITIES in plastics. Liquid marble. "Snow-white," tinted," "molten," "U.S. practice," economical. Colorful composition flooring. Lifetime wear. Low cost. Flexible molds. Make your own. Proctor, Literator, Inc. Compo-Tex, Box 785, St. Louis, Mo.

I'll Share my profit in half with you, and start you in the mail order business, details 5c. Bourdon Units, 519 A. Justin, Glendale, Calif.

Will You give us 5% first \$600 you make? Afternoons free! Work home. Free information reported (exceptional—full time). Expect surprise! National, Box 1240, San Bernardino, Calif.

COLOR Concrete with chemicals. Wishing wells. Stucco. Benches. Spin concrete pottery. Cement artistry. Garden ornaments. Cold glaze. Concrete Statues. Write, Literator, Inc. Hollycon Cement Craft, 8527 Wonderland, Hollywood, Calif.

GOOD Money-making opportunities, details 5c. Sunny's, Riverside, Croton-on-Hudson, N. Y.

OWN A cash business? No selling. Operate "Silver King" vendors, \$3.95 up. Free instructions. Automatic, 2422-A Fullerton, Chicago.

MAKE Color-glazed concrete pottery, statuary, gravestones, tiles, walls, floors, basement waterproofing. Booklet, color plates 10c. National Potteries, Minneapolis, Minnesota.

MAKE Genuine rubber molds. Details 10c. B. Beech, Holbrook, Mass.

ELITE Collection of business plans contains 127 tested plans and scores of formulas. Start own business; make office. Particulars free. Elite Co., 214 Grand St., New York.

WE Successfully sell inventions, patented and unpatented. Write us, if you have a practical useful idea for sale. Chartered Institution of American Inventors, Dept. 4-C, Washington, D. C.

CHARTERS: Delaware; best, cheapest; free. Colonial Charter Co., Wilmington, Del.

FOOLPROOF Rubber, mold making, plaster casting, tremendous market, large profits. 24 page instructive catalogue free. Plastic Arts, 711 Neely, Muncie, Indiana.

WHERE To buy at lowest wholesale prices. Information free. Yorena, Box 25, Bayonne, N. J.

OPERATE Mail order business at home. Details dime. Maples, 3418 South Marshfield, Chicago, Illinois.

Pay Paving business silvering mirrors, plating automats, reflectors, bicycles, bathroom fixtures by late method. Free particulars and proofs. Gunmetal Co., Ave. H, Decatur, Ill.

127 WAYS To make money, in home or office, business of your own. Full particulars free. Elite Co., 214 Grand St., New York.

HOW And where to obtain capital fully explained, free particulars. Star Service, Wapakoneta, Ohio.

Write money by mail, the way we do. Free information. Maywood, P-107 Broadway, New York.

MONEYMAKING OPPORTUNITIES

READ "Progressive Mail Trade" magazine. You get everything—"money-making" ideas, business schemes, tips, trade secrets, inspirational articles—opportunities for everybody. Keep posted. Sample copy 10c. Write, 831 Koscoe St., Chicago.

BIG Profits! Build your own business stamping key check social security plates. Sample name and address 25c. Catalog free. Kemp, 463-P East 178th St., New York City.

150 MONEYMAKING Plans, information free. Wollison, Greenway Station, Tucson, Arizona.

BOOKKEEPERS Make money operating new idea bookkeeping service. Ralph Lee, Vicksburg, Michigan.

NEW Fluorescent kit \$1.89. Money back guarantee. Catalog 25c. Mozart, 1535 N. Ashland, Chicago.

YOU'LL Like resilvering mirrors, tableware, making chipped glass nameplates, signs. Write Sprinkle, Plater, 287, Main, Indiana.

MAKE Statuary, flooring, etc. Imitation marble formula 25c. Ideal Service, 11-H, Park Ridge, Ill.

TWENTY Dollars daily reclaiming lube. Bolsett, Box 483, New Orleans, La.

SIX Repeating money-makers. Free information. Craft, 2070 Edison, Detroit.

125 WAYS To make money with your typewriter. By David Seltz, 148 pages compiled from actual cases, \$1.00 postpaid. Write Shop, A-168, Muskogee, Oklahoma.

OPPORTUNITIES Galore! Two magazines—1 lb. mail 25c. Roberts, 114443 Munich, Chicago.

WHOLESALE Source directory—Rock bottom prices. Free valuable information. Artisto M., Plainfield, N. J.

CASH For butterflies, insects. See Sinclair display advertisement page 12A.

FREE Booklet—Sure-fire money making information, plans, etc. Write today. Box 218-F, Granite City, Illinois.

TEN Ladies' buy, fifty see, buy-sales pyramid \$2.50 starting outfit 25c. prepaid. Scheetz, 98-M Branch, Sellersville, Pennsylvania.

INCREASE income with Angora Wool rabbits! Steady profits; start right! Our instruction manual tells how. Illustrated catalogue wool samples 10c. Clay's Farm, Spaulding, Idaho.

EARN Money with your typewriter addressing envelopes, circulars, typing. Information 10c; none free. Ace-PM, Box 113, New York, N. Y.

YOUR Name on a seashell brochure, 900 percent profit. Sample, price list 25c. Seashell King, Little River, Florida.

SELL By mail for added income. Details free. Kirkwood, 351 Broadway, Tupelo, Mississippi.

MILLION Articles. Buy wholesale. Valuable directory 10c. Ideal Service, D-7, Park Ridge, Ill.

EARN Money at home! Thousands of "Home Worker Magazine" tells how. Sample 25c. Sizemore, Box 7, 4917 North Kostene, Chicago.

SELL By mail! Make sparetime pay with profitable home mailorder business. Constructive literature explains amazing details. Write today. Write Jay, 1123 East 81st, Chicago.

BE A professional scrapbooker. Big fees. Unlimited opportunities. Can be done at home. No competition. No capital needed. Write to Scrapbooker Guild, 59 Park Place, New York, N. Y.

HERE is your opportunity! 15 sources of income. Details \$26. Flush, N. Y.

Will You give us 5% first \$600 you make? Afternoons free! Work home. \$1,000 month reported (exceptional—full time). Expect surprise! National, Box 1240, San Bernardino, Calif.

WHY Work for others? Have others work for you. Splendid profits received. Details (no coin). Dave Bertelson, Antelope, Montana.

FASTEST Growing mail order business of today. Enormous demand. Details free. Charles Schroeder, 56 West Washington, Chicago, Illinois.

AMATEUR Cartoonists, earn big profits, duplicating comical advertising cartoons. Details \$2.50. Write, 1000 Broadway, New York.

WHOLESALE Sources, 500,000 articles. Free directory. Maywood, 1107 Broadway, New York.

FORMULAS, PLANS ETC.

FIVE Complete house plans, "four to six rooms, \$1.00. Home Service, Parkersburg, W. Va.

SINGLE, Double, triple ingredient formulas. Sensational offer free. Baran, Bay City, Michigan.

ARMY Guaranteed to kill ringworm, athlete's foot 25c. Agnes Luzader, Winnfield, La.

MAKE Fast selling products, "Chemist And Formulator." Address free. Kemico, 12-P, Park Ridge, Illinois.

AUTHENTIC Formulary. Instructions and supply sources for easily making 10,000 profitable products. Send \$24.95 (plus \$1.00 postpaid or C.O.D. (Foreign \$1.85). Catalog 3c. Adams Brown Company, Chestnut Hill, Massachusetts.

FREE Formula catalogue. Anything analyzed \$10.00. Western Chemical, Salem, Oregon.

ICELESS Ice! Colder! Cleaner! Cheaper! Instructions 25c. Duffy, Covington, Ky.

ANY Formula \$1.00. List free - W. Simons, 1702 E. Geneva, Milwaukee, Wis.

WRITE US. Formulas, chemical analysis, chemicals, materials. Lakeside, 5319 Greenwood, Chicago.

ELITE Formulas and plans: make and sell your own products. Descriptive booklet free. Elite Co., 214 Grand St., New York.

FORMULAS - Latest, best. Analysis. Literature free. Belfort, Engineering Building, Chicago.

SINGLE-INGREDIENT Formulas. No manufacturing! Information free. A. Kinford, Wayne, Penna.

CHEMISTRY

FREE! Catalog chemicals, laboratory supplies for students, new idea chemicals, apparatus-outfits. Scientific books at discounts. telescopes, microscopes, biological needs, photographic chemicals, scales. Write Winn Mfg., Dept. JET, 124 W. 23 St., New York.

25 TEST Tubes, 4 1/2" resistance glass. 30c. Scientific Exchange, Brooklyn, N. Y.

FREE Catalogue. Chemistry, mineralogy, biology, microscopes, telescopes. Tracey Laboratories, Evansville, Indiana.

HANDBOOK For Chemical Experimenters, hundreds of experiments. Illustrated. 50c. Experiment booklet 15c. Free catalog. Reading Scientific Company, Reading, Penna.

FREE Chemistry catalogs. Supplies at 5c! Equip complete laboratories. Kemkit Scientific Corp., 3917 Bridge St., Brooklyn, N. Y.

CHEMICALS. Laboratory, glassware, apparatus. Send 3c for catalog CP1. Biological Supply Company, 1176 Mt. Hope Avenue, Rochester, N. Y.

SPECTROSCOPE For quick chemical analysis \$2.50. Kutting Sons, Campbell, California.

CHEMICALS In 5c quantities. Catalog 5c. Fleischer's Laboratories, Medford, Mass.

HELP WANTED

LOCAL Agents wanted to wear and demonstrate suits to friends. No canvassers. Partial payment plan. Up to \$12 in a day. No experience necessary. Valuable demonstration equipment, actual samples free. Stonefield, 1300 Harrison, Dept. U-817, Chicago.

PERMANENT Representative wanted for Hoover uniforms to call on restaurants, hotels, beauty parlors, doctors, nurses, others. Excellent income. Leads furnished. Equipment free. Hoover, Dept. UK-106, 251 W. 19th, New York.

FREE Assortment of actual packages foods, groceries, household products worth \$5.00. If you promise to show to friends and neighbors and try to take orders. Fine profits. Spare time. Experience unnecessary. Zanol, 2284 Monmouth, Cincinnati, Ohio.

WILL Start you in the Bible business. Opportunity for Masonic men. Colonel William J. Smith, 1211 Chestnut St., Dept. 603, Philadelphia, Penna.

EMPLOYMENT Advisory instructions and sample brief. 50c postpaid. Nebraska Finance Co., Lincoln, Nebraska.

GROCERIES Free. Just agree to show friends, neighbors, others and I'll give you \$5.00 assortment foods, groceries, etc. free. Amazingly simple way to make good money. Send no money. Just name and address. Zanol, 2282 Monmouth, Cincinnati, Ohio.

AGENTS WANTED

AMAZING Zipper clothesline—Zip garments on or off instantly. Easy demonstration, sure sale every home. Big money. Dunn Mfg., Hempstead, N. Y.

STARTLING Profits selling "Orange concentrate." Delicious natural orange drink. Sell like wildfire. Roadstands, soda fountains, resorts, camps, farmers, big buyers. Sample free to hustlers. Sunset Valley Orange Co., 3357 Clifton Ave., Chicago.

MAKE Big money selling hosiery-lingerie. Outstanding quantities. Low prices. Free selling outfit by return mail. Rauch, 20p W. Jackson, Chicago.

WE Pay you \$5 for selling ten \$1 boxes. 5c. Inexpensive attractive name imprints. Christmas cards. Sell \$1. You make 50c. Free samples. Cheerful Card Co., 51, White Plains, N. Y.

738 SHAVES From one safety razor blade—Magic box does it—sells on sight—guaranteed. Free outfit. Write Razoroli Co., 1220 Builders Bldg., Chicago.

SHAWAY! Your car will save time, money, damage when key lost or locked inside! 50 cents post paid. Agents wanted. Stowaway, Box 2493, Dallas, Tex.

BIG MONEY applying initials on automobile—anything today. Free samples. If you sell printing and advertising specialties we have an excellent sideline featuring Decalcomania name plates in small quantities. "Balco," 727 Atlantic Ave., Boston, Mass.

RAZOR Blade bargains, free wholesale catalog. Bulger, 114D Rindge, Cambridge, Mass.

DISTRIBUTORS - Wholesale insecticides. Profitable repeat sales. Household Products Co., 327 West 120th Street, Los Angeles, Calif.

BEAUTIFUL Lamp made of seashells. \$7.50 dozen. Sample postpaid \$1.25. Ret's Novelty Shop, Boca Raton, Florida.

BIG MONEY taking orders; shirts, ties, hosiery, underwear, pants, jackets, sweaters, uniforms, etc. Sales equipment free. Experience unnecessary. Nimrod, 4922-AN Lincoln, Chicago.

ELGIN, Waltham: wrist watches \$3.25. Send for free wholesale catalog. Louis Perloff, 729 Walnut Street, Philadelphia, Penna.

WINDOW Sign letters. New "Roman" style. Large sizes, penny each. Absolutely beautiful. Free samples. New catalog. Atlas, 7941 Halsted, Chicago.

OPEN Rawleigh routes are scarce but in 1950, Rawleigh's organization expands, offering new opportunities. If ambitious, willing to start with good earnings and increase rapidly write for full information. We supply sales advertising literature—all you need. Rawleigh's, Dept. G-118-PM, Freeport, Ill.

YOU'LL Like resilvering mirrors, tableware, making chipped glass napoleons, signs. Write Sprinkle, Plater, 123, Marion, Indiana.

GAS Stations want this new patented necessity. Knipp, Long Beach, California.

SELL Nylon hosiery and give fine silk suit price in combination order. Guaranteed against holes, snags, and runs or replaced free. Hose for your own personal use given with large outfit. Rush today and receive today. Wilknit, Desk BG-37, Greenfield, Ohio.

FREE Water and our concentrates make 72 products. We supply labels, bottles. Enormous profits. Qualeo E-20930 Russell, Detroit.

"EXTRA-MILES!" Increase your mileage. Reduce expense. 30c profit on dollar. Thermoxm, Peoria, Ill.

AMAZING Cloth removes tarnish from metals without the use of liquid, paste, or powder. retails 25c. Sample free. Baker, Postoffice Box 227, Trenton, N. J.

EVERY Lady buys. One sale leads to every more. Send quarter—\$2.50 outfit. Scheetz, 98-M Branch, Sellersville, Penna.

SELL Kwik-Shine polishing cloths. 75c dozen postpaid. General Merchandise Co., Box 4683 Sta-E, Kansas City, Mo.

SENSATIONAL New tool for making money. Girard Company, Washingtonville, Ohio.

STA-BRITE Glass cleaner. Sample 10c. Johnson Specialty Co., Brookport, Ill.

PLACE Electric razor, brookboard deals, for quick, easy profits. Moran, Box 177-p, Lockport, New York.

AGENTS Make big profits on food products, bargain deals. Low wholesale prices. Rush name for trial outfit offer. Ho-Ro Co., 2810-W Dodder, St. Louis, Mo.

"SWANKY-SERVERS" Easy to sell. Circulars and details free. The Oster-Baker Shop, Rockford, Illinois.

"FREE!" Mexican currios, novelties. 100% profit! Marquez, Apartado 1176, Mexico City.

WE Pack products under your label. Cleaners, food products, etc. Big profits, low prices. Samples free. Bestco, 8007 Irving Park, Chicago.

AGENTS: Smash go prices! Santos coffee 12c lb., 4-oz. vanilla 8 1/2c. Razor blades 100 for \$5c. 100 stick chewing gum 12c. 150 other bargains. Premiums. Experience unnecessary. Carnation Company, P.O. St. Louis, Mo.

AGENTS—300% Profit selling gold leaf letters: stores and offices. Free samples. Metallic Letter Co., 438-B North Clark, Chicago.

ENGRAVED Name plates, numbers, signs, etc., easily sold, profits large. Brett Bros., Winthrop, Mass.

AGENTS: Stamp names on pocket-key protectors. Sample check with your name, address, and sample outfit. Emblem checks, check-fobs, name plates. Hart Mfg. Co., 303 Decraw St., Brooklyn, N. Y.

GOOD Paying business silvering mirrors, making stationery, red roses, bicycles, bathroom fixtures by late method. Free particulars and proofs. Gunmetal Co., 111 E. 11th, New York.

AGENTS—To mail our literature. Good profits. Home business. Maywood, 1105-1107 Broadway, New York.

DO You want agents for your proposition? Your ad in this space will place your message before hundreds of men seeking fast-selling products. My folder "How to Secure Agents" is filled with proof. I'll gladly send you a copy free. John Johnson, Manager Classified Advertising, Popular Mechanics Magazine, 200 E. Ontario St., Chicago.

HIGH-GRADE SALESMEN

ELECTRICAL Wonder machine. One of America's greatest inventions. World's largest exclusive manufacturers of special unit. Tremendous sale—already being used by such nationally known concerns as General Motors, Woolworth's, Sears Roebuck, Coca Cola, etc., but now available to all business factors. Excellent stores, homes, etc. Men earning \$100 to \$150 week. Sold on open account. Free trial for customers—Sells itself. Experience unnecessary. Free demonstrator offer. No matter what you are now selling—answer this ad. Protected territory available. Get in on ground floor of tremendous new market. Salesmanager, 2249 So. Calumet, Dept. R1904, Chicago.

OUTDOOR Advertising thermometers. Sell advertising to merchants, large earnings. Advertising Thermometer Co., 1947 E. 75th, Chicago.

SELL Miracle clean polish wax. Service stations make \$144.00 from \$7.20 investment. Only 24 deals weekly, earning sales \$75.00. Particulars free. Miracle Chemical Laboratories, Maywood, Illinois.

BIG Commissions—selling to stores celluloid pricing tickets, metal shelf moulding. To restaurant and delicatessen markets. Free. Friction, 224 White St., New York.

ADVERTISING Book matches—World's largest "direct selling" book match factory offers advance cash earnings calling on every type of business. Experience unnecessary; full, part time. Low prices for high quality; quick deliveries, help you sell orders. Good repeat profits. Free kit. Instructions. Match, Corp. of America, 3433 West 48th Pl., Dept. E-7, Chicago.

BRUSH Salesmen, distributors—You can make more money with Newway brushes, mops, chemicals, 200 items, higher commissions. Newway Brush Co., Hartford, Conn.

EVERY Business must buy. Printing, ad, specialties, book matches, tags, pricing tickets, etc. 24c. 100 for \$24.00. No line—1000 necessary items at 50% price saving. Free deals. 40c advanced commission. Send for details. Experience not. Outfit free. Willens, 2130 Gladys, Dept. 47, Chicago.

SELL Collection systems. Four sales daily pays \$240.00 weekly. Repeater. Exclusive. Fidelity Mercantile Agency, Roanoke, Virginia.

ADVERTISING Book matches. America's largest manufacturer of union label book matches. Fast selling line. Large sales. Producing kit. Sample match. Complete cut catalog. 13 color combinations makes selling easy. Commission in advance. Supplier Match Company, 7530 Greenwood, Dept. M-7, Chicago.

The Really different line. Write Dept. PM6, P.O. Box 1315, Oklahoma City.

SALESMEN. Distributors. No spill, no slide, no tumble serving tray for sliced watermelon. New. Exclusive season opening. Patent granted. Geo. M. Long, West Jackson, Mississippi.

MEN. Increase your income 100%. Selling guaranteed men's hose and 5 fold creased ties. \$1.00 easily retails for \$2.00 and cost you \$4.50 dozen delivered—hose \$2.00. Wolf-Mark, 931 W. Roosevelt Rd., Chicago, Illinois.

SELL Bargains! Novelties, paper specialties, greeting cards. Big profits! Catalog free! Ellico, B-438 North Wells, Chicago.

WRITE Immediately for fast, proven money-maker. Hustlers cleaning up big profits daily with new popular-priced red-hot easy-selling proposition. Instant, convincing demonstration saves motorists money, time, work. Stores, garages buy quantities. Certified Specialties, Owensboro, Kentucky.

SALESMEN Demonstrators, agents sell a new fascinating game, The Winner. Write National Advertising Service, Herald Bldg., Syracuse, N.Y.

CATALOG Free! Money-makers galore! Diverse Company, Dept. 11, 2311 West Capitol Drive, Milwaukee, Wisconsin.

SIGNS That sell—The brilliant beauty of the new Elite Cut-Out Sign Sign appeals instantly to every business man. Low prices bring orders fast. Huge profits for salesmen. Get in on this. Economic Advertising Displays, 1572-74 North Halsted, Chicago.

MAKE More money selling Red Comet Fire Control Products. Write today for free facts. Red Comet, 704 Comet Building, Littleton, Colorado.

NEW Specialty—Sells every business and professional man. Four \$15 sales daily paid weekly. Farrell & Co., Dept. 1, 800 monthly. Write F. E. Armstrong, President, Dept. PM, Mobile, Ala.

BLADES—Big profits. Best quality. Factory prices. Postpaid. Ace Blades, Buffalo, N.Y.

EXCELLENT Opportunity selling our complete line of brushes, laxatives and soaps. Write for Free Wire Grip Sanitary Brush Company, 2300 5th Ave., New York.

EDUCATIONAL AND INSTRUCTION

"HOW To Break and Train Horses"—A book every farmer and horseman should have. It is free; no obligation. Simply address Beery School of Horsemanship, Dept. 1107, Pleasant Hill, Illinois.

TRADE, Technical and class magazines. Current samples. Books on advertising, printing, engraving, etc. Discounts. Lists free. Commercial Engraving Publishing Co., 34-R North Ritter Avenue, Indianapolis, Ind.

MEN Wanted—Big pay—Learn welding. Free booklet. No. 2. Write to: International Trade Institute, 741-45 W. 70th Street, Chicago.

ENJOY Perfect health. Become professional equilibrist. Free health book. Write! Knoff, 2154MF North 52nd Street, Milwaukee, Wis.

U. S. government jobs now open. New study course. No cost until in government payroll. Free information. Civil Preparatory Service, 1702-A N. LaSalle, Chicago.

LEARN Telegraphy! Splendid opportunities now prevail. All expenses included. Catalog free. Dodge's Institute, Hiatt Ave., Valparaiso, Indiana.

WELDING—Electric arc. Learn profitable trade quickly through actual practice. Individual welder instruction at bare cost of materials. Full book free. Valuable welding class book free. Hobart Welding School, Box M-711, Troy, Ohio.

WATCH Repairing is steady profitable work. Experts usually in demand. You can learn watchmaking trade at home spare time. New original instruction system. Script engraving course included. Write for free details today! Nelson Co., 500 Sherman, Dept. G-2001, Chicago.

NEW Opportunities in air conditioning, electric refrigeration and auto body-fender including metal work welding painting. Many trained men earn up to \$35-50 weekly. Start preparing now. Get free facts. Write: Refrigeration Institute, 1314 Belden, Dept. 117, Chicago.

WANT A super-memory? Write DQ, Info Co., Box 1122, Chicago.

MEN—Women. Get U. S. government jobs. \$105-175 monthly. Prepare now at home for examinations. Full particulars—Specimen preparation—list positions, free. Write today. Franklin Institute, Dept. W3, Rochester, N.Y.

LIFE is a mission. Learn how to fill it and be happy. Wonder Studies, 179 So. Hawley Rd., Milwaukee, Wis.

AUDITING Lessons by C.P.A. Simple. Inexpensive. Information free. Public Accounting School, Box 1534, Memphis, Tenn.

MAKE Your own power work for you. How? Write Wonder Studies, 179 So. Hawley Rd., Milwaukee, Wis.

HOME Study for degree. Psychology, Metaphysics, Philosophy, Bible. Free information. College of Universal Truth, 20-B East Jackson, Chicago.

SECRET Investigation. Experience unnecessary. Chicago City particulars free. George Wagner, M-2640 Broadway, N. Y.

CLINICAL Laboratory technic taught in your own home. Practice outfit supplied. Bulletin free. Imperial Biblical Institute, Box 494-E, Elkhart, Indiana.

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Vol. 76

JULY, 1941

No. 1

The SEARCH for SUBSTITUTES

MR. AND MRS. AMERICA soon will be using many commonplace things made of "ersatz" materials—substitutes for certain metals, rubber, silk, cork and special woods that must be conserved to insure adequate supplies for national defense purposes.

Governmental agencies and private research experts are in the midst of an intensive hunt for "ersatz," a hunt that already is yielding important results. The good news for the consumer is that in spite of the sweeping changes ahead he most likely will be as pleased with the substitute products as he was with those made from the materials replaced. In some cases, he may not even be aware that changes have been made.

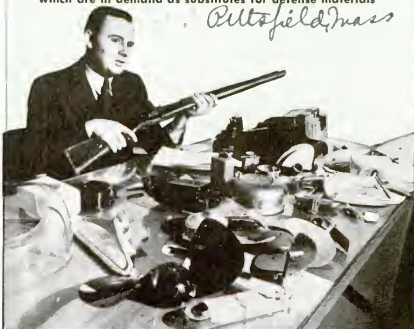
From the field of plastics are coming substitutes from which hundreds of articles, formerly composed wholly or in part of aluminum, magnesium, tin, chromium and zinc, can be made. Already it has been found possible to employ plastics as housings for vacuum cleaners, household machinery of all kinds and business machines. Fan blades,

Right, H. M. Richardson, plastics engineer, studying articles that may be produced economically in plastic materials. Among the articles on desk are fan blades, hair-drier hoods, soap dispensers, vacuum-cleaner nozzles, business machines and a gunstock



Above, reflectometer in General Electric laboratory tests plastics which are in demand as substitutes for defense materials

Pittsfield, Mass



JULY, 1941

*Les & Plastics Dept.
Pittsfield, Mass*



Substitutions which Ford engineers find possible to make in interior of automobile to release materials vital to national defense

camera cases, cosmetic cases and vanity cases, airplane parts, hair-drier hoods and instrument handles and cases are just a few of the more common articles in whose manufacture metals are being replaced by plastics. In the refrigerator industry, plastics can be substituted for large areas of thin-gauge aluminum and steel in making freezer doors, panel and drawer fronts, knobs and control panels.

A trend to increasing use of plastics in the automobile is being encouraged heartily by the necessity for conserving mate-

Rubber blocks cushion path of army tanks, therefore rubber conservation is important. These tank blocks are pictured in Goodyear plant



Also essential to defense is rubber for making flotation bags, shown in Goodyear factory, which protect land planes forced down on water



rials vital to defense. The 1941 models display instrument panels, door handles, control knobs and interior trim made of plastics, and E. I. du Pont de Nemours & Company reports there are at least 50 possible uses for plastics in automobiles. Not far in the future may be the car with body panels made of plastics. The Ford Motor Company is in the midst of a development pointed in that direction. Prospects are good, too, that airplane fuselages and wings may be molded of plastics, thus releasing large supplies of aluminum and stainless steel for other purposes.

A plastic finish for containers has been announced by the Reynolds Metals Corporation as a substitute for aluminum foil on the outside of packages of tea, coffee and other products that are easily contaminated. Oiled paper, glassine, lead foil and Cellophane also may be used instead of aluminum foil for many purposes.

Synthetic resin enamels are being tested as substitutes for tin in coating certain types of cans. A committee of the National Academy of Sciences estimates that 12,000 long tons of tin might be recovered an-

Federal Reserve Bank Richmond, Va.

2435

Goodyear Tire & Rubber Co
Akron, Ohio

nually from old tin cans.

The housewife may find herself using old-fashioned cooking utensils, such as earthenware, enamel kitchenware and cast-iron pots and pans, because supplies of aluminum to utensil makers may be curtailed for the present. A curb on the distribution of stainless steel utensils also may be expected. One result of this change in the "American way" of living may be to increase the demand for flameproof glassware which is gaining favor rapidly.

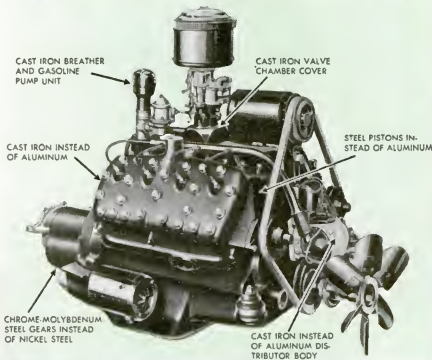
Research laboratories of all the automobile companies are feverishly hunting for substitutes as the defense requirements begin to outweigh commercial needs. Auto radiator grilles, made chiefly of zinc, may disappear entirely—and the average owner may welcome this change because to him

Sharon Pa
Below, Westinghouse worker winding transformer in which new type steel core reduces amount of copper wire required



Above, bullet-seal fuel tanks for military aircraft being inspected

Below, points in Ford engine at which substitutions can be made



that grille is only something that he finds dented after parking. The grilles call for about 76,000 tons of zinc each year and zinc happens to be an important ingredient in manufacturing brass, from which shell cases ranging in size from rifle, to gigantic coast-defense gun are made.

Typical of the automobile industry's efforts is the work of the Ford company, whose research men have found ways to effect an 80 percent saving in the amount of nickel the company uses, a 50 percent saving of aluminum and a 50 percent sav-

(Continued to page 186)

Motorboat With Clipper Hull Has Plastic Glass Windows



Notice how the plastic glass windows bend to accommodate themselves to curves of the cabin. Boat rides high on the water

Plastic materials and aeronautical design are combined in a speed cruiser built to sell for around \$1,000 and to operate at less than three cents a mile. Extreme light weight is achieved by the use of plastic-bonded plywood and windows of Plexiglas, the plastic used for enclosing cockpits of military planes. This saves half the weight of plate glass. The ship's hull is patterned after that of the Boeing "Clippers." Large sheets of plywood are used on the "stressed skin" principle, making a single unit of the planking, ribs, keel and deck house, requiring only one-fifth as many seams as conven-

tional construction. The flexible windows slide in curved runners following the curves of the cabin, to which they adapt themselves. The boat skims over the water at high speed with little spray, its "flying stern" riding high to permit level planing.

'Machine Gun' Fires Bulbs For Sequence Pictures

Fast action sequences of night and indoor sports may be captured by a "machine gun" flash camera developed by Charles Gatschet, news photographer of the Des Moines Register and Tribune. Two years ago the newspaper began taking sequence pictures of football players by daylight, but the camera couldn't be moved indoors for basketball or bowling shots. Now Gatschet has succeeded in arranging an automatic relay of synchronized flashes, timed to take pictures at a rate of ten per second at distances up to 90 feet. In place of the 12-inch lens, a 3 3/4-inch Zeiss Tessar 3.5 lens was installed, and a battery of six flash bulb reflectors was mounted on a tripod with the camera. An automatic relay was added, to switch from one bulb to the next; when the flash contact breaks open, a cam on the shutter shaft revolves, making contact with the switch which throws it to the next bulb.



Synchronizer fires a sequence of bulbs with high luminous peak

L442 Chrysler Corp., Detroit, Mich.

U. S. Army's 28-Ton Tank Packs a "75" Gun

Aberdeen, Md.

Beginning to roll off assembly lines in large numbers, the army's newest 28-ton medium tank is acclaimed the most powerful armed fighter of its size and type. It carries a 75-millimeter field gun, a 37-mm. anti-tank and anti-aircraft gun mounted in a power driven turret, as well as several machine guns. In tests the speedy "fortress" lumbered through sandy fields at 25 miles an hour, firing its cannons with remarkable accuracy.



L422

Fire Bomb Put Out With Extinguisher Shot From Gun

Girls in London have formed a fire brigade to help extinguish incendiary bombs dropped by air raiders. They use special guns to discharge a compound which smothers the blaze quickly. Members of the corps wear tin hats fitted with "visors."



Two views of the army's newest 28-ton mechanical monster going through paces before a group of U. S. officials and British representatives



Helmeted fire-lasse making two-gun attack on bomb

acme

L437

\$2,500,000,000 Paid for Smoke

People of the United States pay \$2,500,000,000 annually for smoke, according to investigators who reported their findings to the American Gas Association. Loss in fuel alone, due to the incomplete combustion which causes smoke, amounts to \$200,000,000 they said. The remainder is spent in extra cleaning of buildings, laundering or dry cleaning of apparel and house furnishings, and replacing things which have a shortened life because of smoke.

JULY, 1941

Testing Laboratories
Cleveland

Model Assembly Line Shows Cars in Making

How automobiles are made is revealed by a working scale model which is a feature of the Plymouth Motor Fair now touring the United States. The model shows assembly-line work which results in the apparent production of cars 2½ inches long. Eight mammoth trailers house the Plymouth exposition. In one of them is a complete movie projection booth for three-dimensional pictures in technicolor. Others transport the "big tops" and canvas crews, a "talking Plymouth" and other paraphernalia. The traveling show also includes a power house on wheels which generates all the electricity for the exhibits. Generators coupled direct to the crankshafts of two Chrysler Diesel engines supply current for numerous electrical displays in the two big circus tents and three huge searchlights.

Left, two views of model factory. Center, closeup of assembly line. Below, the Motor Fair on the highway



Cont. of Stirling Switchell, chm., new Center Bldg.
Electr., much

cut over engine
1/2 in.
motor crank

Engineers Plan Roads on Scale Model of City



Every building in this miniature city is an exact reproduction of an actual building in downtown Los Angeles

From probably the largest city in the world in area, Los Angeles is being reduced to one of the largest scale models. The miniature city, 24 feet square, reproduces the downtown section of the Cali-

fornia metropolis with every building and street shown in faithful detail. It is being built on a scale of 50 feet to the inch, and will cost \$100,000. City engineers expect to use it in planning future streets.

Keyless Lock for Auto Door Cannot Be Forced Open

Installed in the car door on the driver's side, a special combination lock may be set either to open when a dial is turned to the proper numbers, or to unlatch in the ordinary way. When the combination is set and the other doors are locked from the inside, it is impossible for thieves to enter the car by forcing the lock. No key is used, the driver merely turning the dial to the three numbers making up the combination to unlock the door.

(Names and addresses listed in the index, page 4-A, show where to buy manufactured products described in this magazine. Say you saw it in Popular Mechanics.



Keyless car-door lock is opened by combination and cannot be forced open by thieves trying to enter

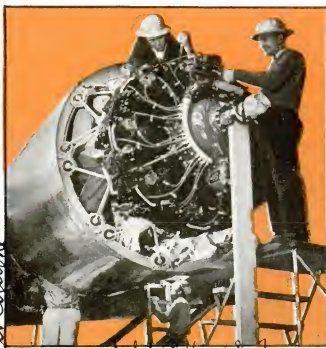
*L. V. Surger, Grover
542 N. Kilbuck
Los Angeles, Calif.*

MAN-O'-WAR with WINGS



HOW can an airplane fly slower at 200 miles per hour than another airplane flying at the same speed?

That's ridiculous, of course, yet your eyes are apt to tell you it's so, the first time you see the gigantic B-19 "hemisphere war-fender" in the air. This tremendous war-plane is so big that when you watch it you get the illusion of slow speed, even though a smaller airplane nearby seems to have to hurry to keep up with it.



View of one of the flying battleship's 2,000-horsepower engines being installed. The four engines develop 8,000 horsepower for takeoff, the turbine capacity of a medium-sized ocean liner

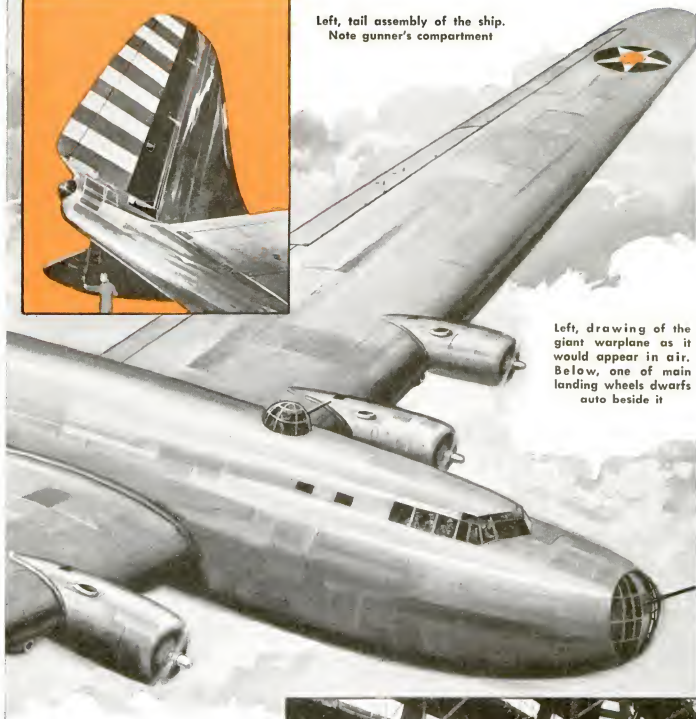
Think of an airplane so large that its wing span is greater than the height of a 17-story building—that's the B-19. You could park a full-sized passenger transport under each wing, with a light bomber under each wing of each transport. You could hide a couple of light sport planes under the elevators. Mechanics can walk upright inside the wing. A railroad tank car of gasoline is needed to fill its fuel tanks. Its landing wheels, weighing more than a ton

Capt. Thomas E. Stinson, Jr. 3872 Franklin Ave
 Los Angeles, Calif.
 Wright
 Blue Cross

Left, tail assembly of the ship.
Note gunner's compartment

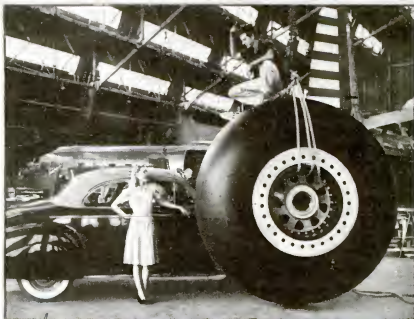


Left, drawing of the
giant warplane as it
would appear in air.
Below, one of main
landing wheels dwarfs
auto beside it



each, have to be handled with a crane.

No human pilot has the strength to work the vast control surfaces. The rudder alone has 237 square feet of movable surface. The landing flaps have an area large enough for a transport wing. The pilot could no more push such surfaces around with the strength of his arms and legs than a mosquito could push a barn door open against a hurricane, so a power steering system is used. The pilot's



JULY, 1941

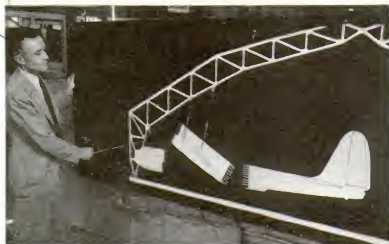
Ref: Jack Anderson, Public
Relations Dept. Douglas
Aircraft Co., Santa Monica, Calif.

2530

Douglas Engineers.
David Dwyer



It takes four men to turn one propeller over by hand, so auxiliary engines start the main engines



Above, models used in practicing assembly of the bomber's sections

conventional wheel and rudder controls are attached to small control tabs on the respective main control surfaces and the action of each tab starts the big control surface moving, after which hydraulic pressure takes up the work.

The ailerons are so long that each is built in two sections to prevent binding, because the wing has an up-and-down tip deflection of 12 feet under some flight conditions.

Five years ago the Army Air Corps decided that it wanted to test a super-

Wright Duplex Cyclonic
airplane. It asked the Douglas Aircraft Company to swear a staff of its employees to secrecy, hang a curtain across one end of its factory, and build an aerial battle-ship. What was desired was no experimental airplane but a tremendous bomber, practical and complete and able to take care of itself while conducting its long-range missions.

Since then four acres of drawings have been made, and 500 engineers and mechanics have spent more than 2,000,000 hours in research and construction. The wing of the plane that they built is a tenth of an acre in size and has a spread of 212 feet. The plane has a gross weight of 160,000 pounds, including a total load capacity of 28 tons. Its four main engines develop 8,000 horsepower for take-off, the turbine capacity of a medium-sized ocean liner. With reduced load the airplane can maintain altitude on any two engines. It could fly one-third of the way around the world nonstop.

The plane carries a flight crew of 10 men, exclusive of gunners. Defensively the plane has no blind spots, every approach being guarded by machine-gun nests and small cannon.

Huge and complicated as the B-19 is, its heart consists of noth-

Below, adjusting brakes while one man phones readings to the cockpit





This view of the B-19 inside the factory gives you an idea of its size. The wing span is greater than the height of a 17-story building and the wing surface is one-tenth of an acre in area

ing more than one small 12-volt storage battery. This battery furnishes the current to start the two auxiliary engines that in turn supply the current for starting the great flight engines. The two auxiliaries are mounted inside the fuselage and develop enough current to light a large department store. Hydraulic power taken from one of the main engines makes the airplane largely independent of ground facilities. The plane can operate its own hoists for changing the 16-foot diameter propellers, for lowering the main engines to the ground and raising them, and for lifting supplies on board.

The retractable tricycle landing gear weighs more than a small scout-bomber. Each main tire, eight feet high, is of 24-ply construction and contains 150 miles of rayon cord and three miles of steel wire. The steel in the two

main legs and the nose strut weighs two tons.

Such a monster airplane requires many things not needed on smaller craft. On the B-19 the engineers installed a fire alarm system, a 24-station telephone system, and a loud speaker warning system. Steam boilers that are heated by the exhaust

(Continued to page 191)



Right, how the air monster's sleek fuselage is kept dusted

*Boardley Chandelier Mfg Co
216 S. Jefferson, Chicago*

Bathroom Light Has Outlet For Plugging In Shaver

L 454



Arrow indicates shaver plugged into side of fixture

Offering special convenience for shaving, a new bathroom light fixture contains a plug-in socket for the electric shaver or other appliance. The top portion of the globe diffuses the light, while a good light is thrown downward to the face.

L 371

Midget Truck and Trailer Speed Hauling of Nursery Plants

Replacing the slow-moving wheelbarrow for hauling plants and material on nurseries and ranches, an undersized truck



Driver straddles tractor seat while towing trailer

and trailer have been built by William Quiggle, of Monrovia, Calif., using various automobile parts. Three horsepower from a one-cylinder air-cooled gasoline engine is enough to drive the vehicle at a top speed of 16 miles per hour. With two small auto transmissions the tractor, or truck, has nine forward and three reverse speeds, and a double belt drive, controlled by a clutch, connects the engine with the drive shaft below. The differential, front axle, brake assembly and steering gear were all taken from old cars. Riding on six steel wheelbarrow wheels equipped with 4-by-16 tires, the tractor has a wheelbase of 39 inches and a tread of 25 inches. The trailer, with a bed bottom made of $\frac{3}{16}$ -inch plate steel two feet wide and seven feet long, has removable sideboards so bulky loads may be accommodated.

L 365

"Cluster" Aerial Bomb Spreads Damage Over Wide Area

More effective and widespread damage by air raiders is believed possible with a



Small bombs clustered about big one multiply damage

new kind of "cluster" aerial bomb invented by Jacob Baker, of Cleveland, O., who has sent a model and blueprints of his missile to authorities in Washington. It consists of a large bomb with six smaller ones clustered about it in such a way that they may be released from the "mother" bomb at any predetermined height.

2396 Boeing Aircraft Co. Seattle Wash Clipper Outpulls Tug in Power Test on Surface



Above, the tug pulls back as the Clipper tests its four engines.
Below, the first trial flight

Just before the new Boeing Clipper took off for its first flight recently, it engaged in a tug of war on the waters of Puget Sound with a tugboat. The Clipper won. With the tug's engine in reverse, the four 1,600-horsepower engines of the transoceanic flying boat easily pulled it forward. The purpose of the maneuver was to keep the Clipper from taking off while its motors were turned on for a full



power test. On the actual takeoff the big ship lifted itself from the water after a 1,000-foot run. This was the first of six new Clippers built for Pan American Airways.

Power Bicycle Has Auto Seat and Clutch-Brake Pedal



Better driving comfort is claimed for a power bicycle that embodies some features of the automobile. The driver sits in an air-cushioned chair-type seat, with his feet on the floor ready to use the combination brake and clutch pedal, and he steers it like a bicycle. Extra-large tires help make riding easy. Made of electrically welded tubing such as is used in the construction of airplanes, the vehicle weighs 125 pounds. A 1½-horsepower engine drives it at a top speed of 35 miles an hour.

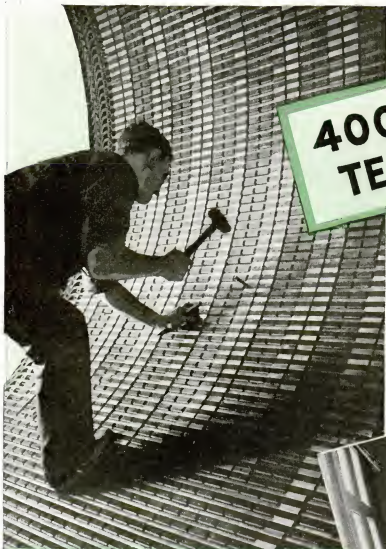
Motor-driven bicycle has auto seat and combination clutch and brake pedal in the floor

2473.

400-MILE WIND TESTS PLANES

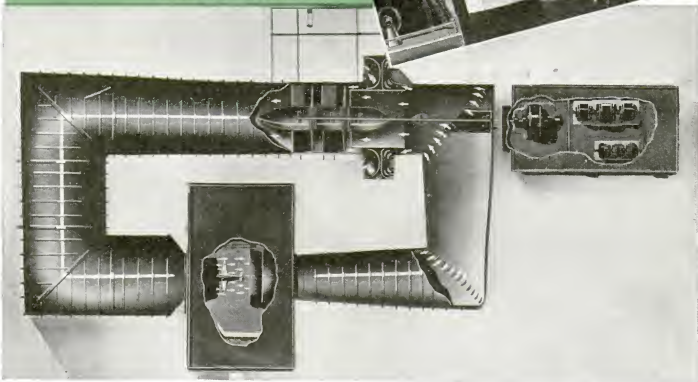
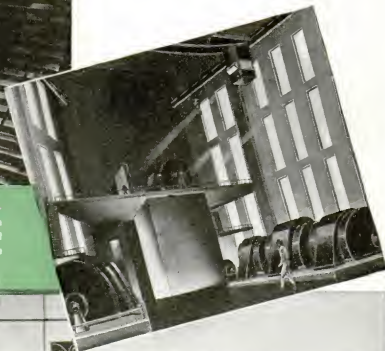
Clayton Ellis

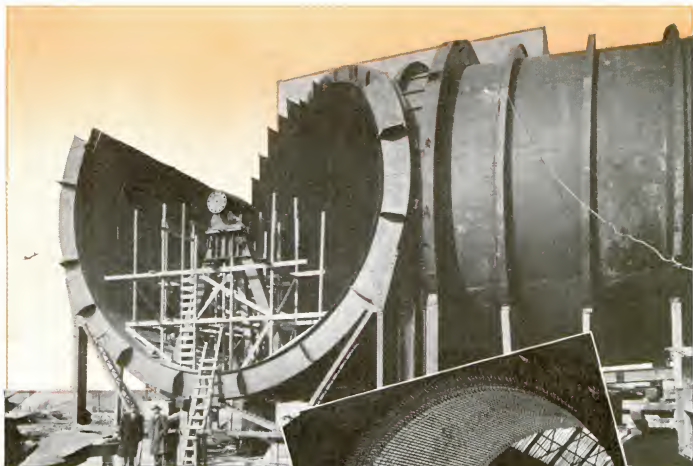
Wind speeds up to 400 miles per hour will be employed at Wright Field's new testing tunnel. Scale model airplanes will be subjected to blasts created by 40,000 horsepower motor and fans. Left, Westinghouse craftsman working in stationary part of motor. Below, drawing of power building's interior



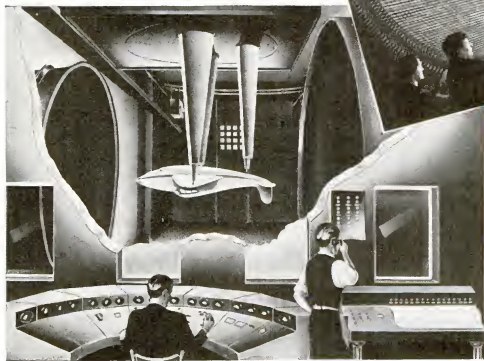
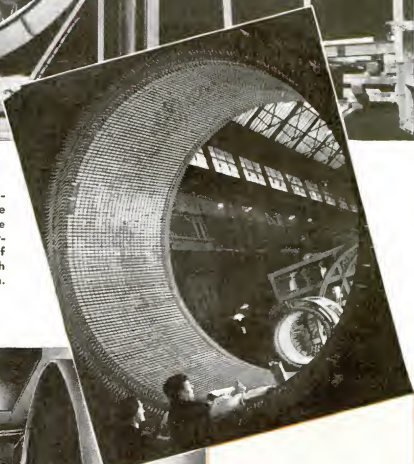
Below, drawing of tunnel with arrows indicating counter-clockwise course of airstream and with airplane model suspended in front of jet. This view would be from above the completed tunnel

Charles D. S. Army Air Corps





Above, 20-foot tunnel nearing completion at U. S. Army's Wright Field. The tunnel narrows from 45 feet to 20 at the jet. Right, Westinghouse workers putting finishing touches on windings of stationary part of big fan motor which will drive two 40-foot fans in tandem. The fans will be made of wood



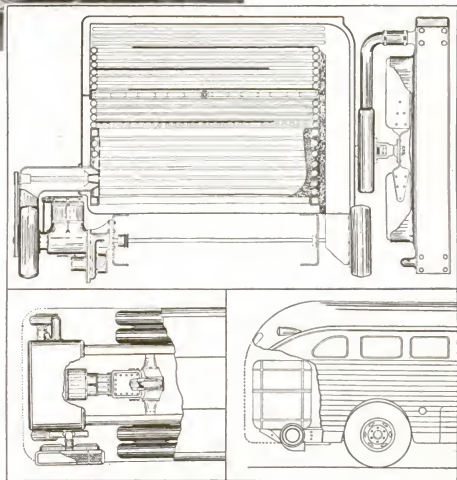
Left, drawing shows how engineer in sealed, air-conditioned control room will test model plane, shown in inverted position, while assistant at right will watch instruments which automatically record pressures, velocities and temperatures. Hurricane-like wind will pass from jet at left over the model and into the return throat at right

Automatic Steam Plant For Trucks or Buses



Left, steam-power mechanism mounted in stationary frame for a test

Below, sketches of the steam generating system (top) and of proposed location of plant in bus. Bottom, left, looking down on bus and, right, side view



Combining steam power with an automatic control system, a new method of propelling trucks and buses has been developed. It includes a high-pressure steam generator producing up to 2,800 pounds of steam per hour at a pressure of 1,000 pounds per square inch. Electric ignition provides instantaneous starting. The inventor claims that steam pressure of 900 pounds per square inch can be generated in about two minutes after the burner starts. The flow of oil to the burner and the flow of water to the generator are proportioned automatically in accordance with steam temperature and pressure conditions. At a certain temperature, or a certain pressure, the control system cuts off the burner. Heavy fuel oil, costing from two to four cents per gallon, may be used. The inventor's plans call for use of a final direct drive, with the engine mounted over the rear axle. No clutch, transmission or universal joints are contemplated between the steam engine and the point where the steam is used. The automatic controls are

said to make the system explosionproof. The inventor proposes to use a four-cylinder engine in conjunction with other mechanism, all of which would have only 10 percent as many moving parts as the ordinary gasoline or Diesel engine used in trucks and buses.

Automobiles, trucks and buses registered in the United States in 1940 reached a record total of 31,468,887.

Frank S. Thomas, Jr.
of Martin
Dobson
on 8/4

NEW SINEWS *of* WAR



From electric furnaces like this one at Carnegie-Illinois Steel Corporation, come the tough metals necessary in modern war machines. Here workmen are shown bottom-pouring a stainless steel heat, a dramatic step in the process

© Weylandt material



2161.
Above, tapping an electric furnace heat, one point in process of producing the "sinews of war," at the South Chicago works of Carnegie-Illinois Steel Corporation

Below, 60-foot steel sphere in which model airplanes are tested at Langley Field, Va. The sphere contains a wind tunnel 12 feet in diameter and about 30 feet long

By Julian P. Leggett

Carnegie Inst. Pittsburg, Pa.
POUNDING across the desert an army on wheels attacks and captures one objective after another, then moves quickly in pursuit of the enemy. The world watches and marvels, not so much at the stamina of fighting men as at the ruggedness of fighting machines.

Tanks, scout cars, truck transports and mobile artillery surge on day after day with hardly a pause for repairs—proof of the progress that has been made in developing new, and improving the old, "sinews of war" since 1918.

Back of the improved performance of the fighting machine is the untiring research man, bending and twisting a piece of steel, studying how to make it harder or corrosionproof or lighter without reducing strength. For steel may well be regarded as the principal sinew of war; upon the development of new forms of it or improvement of old may depend not only the lives of soldiers but also the fate of a nation.

Stainless steel leads the parade of developments, not because it was unknown at the time of the World War but because it was so new then that no attempt was made to utilize it. In





Despite the toughness built into modern steel armor plate, this is the kind of damage a modern projectile, of the size shown, can do. This is result of test at Aberdeen, Md.



And here is the kind of gun, a huge coast defense weapon, that can sink a battleship with a direct hit. Generally a 16-inch shell can penetrate armor 16 inches thick

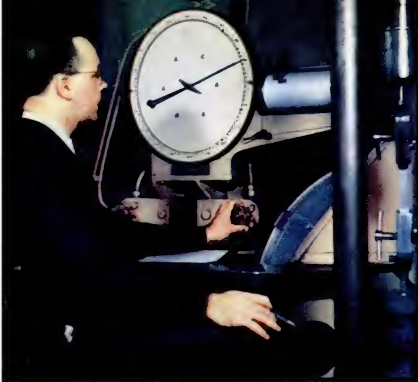


Above, view of blooming mill from rollers' pulpit. Below, slabs being rolled to reheating furnace. The rolls are electrically operated from booth at left

fact, the first big commercial order for stainless steel in the United States was not placed until 1924 when E. I. du Pont de Nemours and company, purchased \$400,000 worth of it as the basic material for nitric-acid towers. In contrast to many things developed for peacetime uses and snatched up by the war-makers, stainless steel resulted from an English chemist's search for a gun barrel lining that would resist erosion and fouling. He prepared a series of steels with a chromium content varying from six to 15 per cent. By accident he noticed that the specimens resisted etching reagents employed in his studies. Unable to market his new form of steel as gun barrel linings, he hit upon the idea of using it for making cutlery and thus began a new industry.

But a corrosionproof metal like stainless steel could not be confined to cutlery. The aviation industry has found it useful in dozens of applications, such as fire walls between engine and pilot's compartment, elevator frames, ailerons, fuel tanks, tail booms, rudder frames and even entire wings. Fighting and bombing planes include much stainless steel; not far in the future may be all-stainless-steel aircraft.





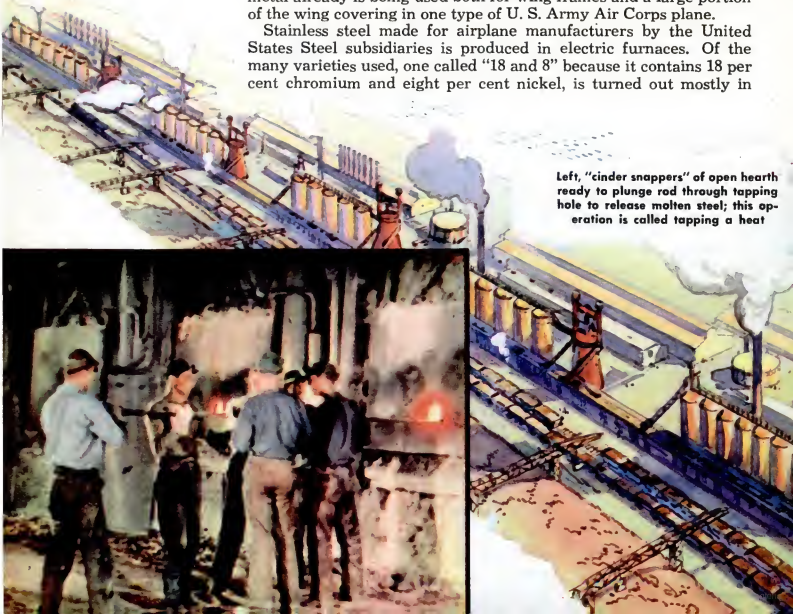
2151 Conducting test on small strip of steel shown suspended in machine (extreme right in picture). This, as well as many other tests, helps make steel better



Flaming, rumbling and smoking, this electric furnace is one of the many making the tons of stainless and other alloy steels necessary to national defense

20 Back in 1931 the Edward G. Budd Manufacturing company built an experimental plane of that metal, except for wing and tail coverings. It was flown by many pilots, twice crossing the Alps, fully loaded, at 16,000 feet. When it was dismantled a short time ago, its structure was found free from signs of wear, deterioration and corrosion. The metal already is being used both for wing frames and a large portion of the wing covering in one type of U. S. Army Air Corps plane.

Stainless steel made for airplane manufacturers by the United States Steel subsidiaries is produced in electric furnaces. Of the many varieties used, one called "18 and 8" because it contains 18 per cent chromium and eight per cent nickel, is turned out mostly in



Left, "cinder snappers" of open hearth ready to plunge rod through tapping hole to release molten steel; this operation is called tapping a heat





Here steel is being poured in a white-hot stream into an ingot mold by operator at right while man at left takes a sample for one of the many tests necessary



In this natural-color photo, metallurgical observer is gauging the heat of a stainless steel slab with an optical pyrometer. Its color is indication of temperature

2151
sheets and strips. A typical sheet is 36 inches wide and 20/1000 of an inch thick. The final product, a shining band 3,000 feet long, has been rolled from an original slab length of 18 feet without a change in width. At one point in the production process, it has been heated carefully for about 10 hours to a temperature over 2,300 degrees Fahrenheit. Another stage is the rolling of the slab from a length of 18 feet to one of 465 feet in an 80-inch continuous hot strip mill. The utmost care is exercised here by the operators, since all factors must be

controlled with precision. Because of the size and complexity of the job, workers communicate by telephone, whistles and a variety of colored signal lights to coordinate their efforts.

Some other aircraft uses for stainless steel include ammunition boxes, feed and ejection chutes, bomb chutes, bomb racks, cartridge cases on machine guns and flare chutes.

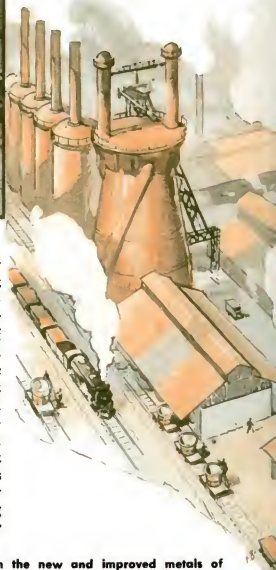
A second development since the World War is the considerable expansion in the family of alloy steels. Whereas only a com-

Another Kodachrome picture, showing white-hot liquid iron pouring into ladle at left. This view is of a blast furnace





Another step in process of producing metal for war—or peace. Here we see workmen at the Carnegie-Illinois Steel Corporation plant removing the slag from an electric furnace heat. Thus is the steel freed of impurities in the ore



2151
parative few were known and widely used in 1914, today there are scores, each made by a precise formula to meet a specific requirement. The Society of Automotive Engineers has adopted a list of more than 100 alloy steels for use in making various parts of automobiles. Many of these have been adapted to the war machines. Tanks must have gears which will deform elastically under the terrific strain suddenly imposed on the driving mechanism, but those gears must not break and thereby delay a campaign such as the British have been waging in Africa. The Caterpillar Tractor company, after exhaustive search, hit upon a special alloy steel from which gears could be made that would stand up under such machine-wracking conditions as stump pulling on the farm. This alloy, first used many years ago, has gone into thousands of tractors, including many purchased by the United States Army, and similar

Below, workman in mask and protective clothing is shown performing another steel-mill operation known technically as "scarfing"



Below, from the new and improved metals of today are produced the war tanks which travel far and fast with a minimum of servicing





Above, charging molten iron from blast furnaces into an open-hearth furnace for refinement into steel. Improvements in production methods have resulted in stronger "sinews of war"

Below, molten steel from open-hearth furnace being poured into molds at Gary works of Carnegie-Illinois Steel

23 alloys are employed in war tanks, enabling those fighting machines to plunge across ditches, batter down trees and fences and even fortifications, buck heavy sand and speed along highways at speeds undreamed of 25 years ago.

Other alloys are found in the engine of these tanks, as well as in the protective armor in which they are encased. Chromium, which makes for hardness in steel, is one of the magic words when the conversation gets around to alloy steels suitable for war machines and weapons. Some chromium is used in steels in combination with other alloys for armor-piercing projectiles. One of the U. S. Army's 16-inch guns can hurl big projectiles accurately at a target 30 miles out at sea. The largest shell in U. S. artillery, it is fired by coast defense guns. This 16-inch projectile can penetrate 16 inches of steel before its mighty charge sends pieces of its heavy steel body with such force in all directions that one direct hit can cause damage sufficient to sink any existing battleship.

Similarly, alloy steel with desir-





2151
Small Endogas generator in Westinghouse laboratory. Note flame shooting from its "mouth." Endogas is used in heat-treating parts made of steel

Below, still glowing after being stripped of their molds, these hot ingots are on way to the soaking pits. This is a natural-color photograph

able hardness qualities is employed in the armor plate protecting a warship at which the coast defense gun may be firing. And throughout the battleship, in engines, fire tower, driving gear, gun controls and scores of other places, the alloys are doing a job.

In the giant bombing plane and the midget fighter, the alloy steels play an important part. In the engine their great strength has contributed to a sharp reduction in weight. Whereas the original Wright plane engine weighed 21 pounds per horsepower, today's radial air-cooled engines weigh as little as one pound per horsepower, and are much sturdier, more powerful and efficient. Alloy steel requirements for the American aviation industry as a whole range from about one-fifth of a ton for a small private plane to six and one-half tons or more for a large transport. These estimates do not include stainless steel or steel wire, bolts, nuts and screws.

Molybdenum, a white metal of which the United States has an adequate supply, is becoming more and more important in the alloy steel field as supplies of other metals employed in similar manner are threatened by war blockades. As

(Continued to page 176)



2451

Quick Test Shows Student's Fitness for Flying

To foretell a student's probable flying ability, an "aviation aptitude tester" is used by the U. S. Navy. With it the prospective pilot's ability to do two things at once, his general reaction time, color blindness, angle of vision fatigue, and other characteristics are tested accurately in three minutes. The device, invented by Lieutenant Commander Henry W. Wickes, U.S.N.R., stationed at the Naval Reserve Base at Floyd Bennett Field, requires the subject to keep both hands busy. As six lights mounted on the panel flash on individually in red or green, the student is required to press the correct black buttons with his left hand to put them out. With his right hand he must keep the pointer in the center of the dial at his right whenever it moves off. The mechanism is set to operate mechanically in advance, and two clocks record the subject's speed of reaction. The in-



Meters register student's dexterity and speed as he turns out red and green lights and keeps needle in center of the dial

strument is said to be useful also in testing bus drivers, motormen, railroad engineers, and machine workers.

Electric Belt Sander Cuts Inner Edges of Sawed-Out Scroll



Note how sand belt is pressed together by idler wheel so it will operate on inside edge of scroll

Painstaking handwork with the coping saw may be saved with an adjustable belt sander that has many applications in carving, shaping, sanding and polishing wood, plastic and metal. Simple and curved edges roughed out are quickly finished with this "Bandsander." To sand the inside edge of a circle or opening which has been drilled or cut out, the belt is removed from the upper pulley, threaded through the hole in the work and replaced on the pulley. Then the two portions of the belt are brought closely together by means of two idler wheels above and below the work table. The table tilts to a 45-degree angle, permitting a wide range of beveling on curved or straight edges, or the chamfering of corners. The tool will carve plastic costume jewelry, prepare it for buffing with a fine grit band, then finish it with a plain cloth band and buffing compound. Designed to operate on motors of one-sixth to one-fourth horsepower at 1,750 revolutions per minute, it may be run faster or slower by means of step-pulleys. Narrow bands may be used for intricate patterns.

✓ L 455.

Odd-Shaped Boats Rescue British Engineers



Odd-shaped motorboats are kept in readiness for rescue work by the British army at its engineering school based in Northern Ireland. During the course of training it is not unusual for men to fall into the water. The boats are ruggedly built to pound speedily through the heaviest seas when accidents occur.

One of the low, flat-top boats used by British to rescue men from the sea

L 480

Midget 'Range' Trains Riflemen In Tenth the Usual Time

Expert marksmen are being turned out rapidly for Uncle Sam with the aid of a compact and self-contained "rifle range" invented by Corporal Paul H. Fidelman of the Marine Corps. It is designed to teach soldiers to fire accurately in one-tenth the normal time required for training.



Portable "shooting gallery" said to speed training of marksmen for army

L 479

Mechanical "Foster Mother" Feeds Six Puppies Orphaned at Birth



Thanks to the ingenuity of their owner, six week-old springer spaniel puppies, made orphans at birth by the death of their mother, are alive and thriving. To feed them all at one time every three hours, a mechanical "foster mother" was fashioned by mounting six nursing bottles upside-down on a board and an inner tube. Mealtime finds the pups helping themselves.

Associated Press - News Photos

2417

U. S. Army Trains 'Panzer' Force at Ft. Knox



One of Uncle Sam's big tanks, above, lumbers up for a target "attack" at Fort Knox, Ky., where "panzer school" is in session



To make gunnery practice with a 37-millimeter tank gun realistic, (above) it is mounted on a rocking foundation



At the U. S. Armored Force School at Fort Knox, only one of its kind, men are trained to man and maintain tanks, trucks and other mobile units. Left, tank corps "rookies" engage in gunnery practice; above, aiming a machine gun at an electric target as miniature tank crosses it



Camera Features, 114 W. 16th St. New York

23 31 Carl Thomas & Son, Inc.
3872 Franklin Ave
San Francisco, Calif

GUARDING OUR



Above, tower from which observers watch part of big petroleum refinery

Left, sentry at post on roof of Douglas factory watches field activities

AMERICA paid a toll of hundreds of lives and millions of dollars in destroyed property to saboteurs during the first world war and today Uncle Sam is resolved that history will not repeat itself.

Our most vital defense industries are already safeguarded against foreign spies and agents, and similar precautions are being taken by other industries also important in defense. Munitions plants and aircraft factories, especially, are on guard inside and out.

Armed sentries are on patrol 24 hours a day and others keep watch from observation towers. Many ingenious ways of guarding against subversive agents have been perfected, but a large number of these are kept secret to prevent spies and would-be saboteurs from knowing what to expect. One protection being widely adopted is the use of infrared fences that consist of

invisible strands of infrared light. Such a fence automatically turns in an alarm when one of its strands of "black light," which is invisible to the human eye, is broken by an intruder. Presence of the fence is impossible to detect when both the source and receiver are properly hidden.

One recent improvement to the infrared fence is the use of beam splitters, each of which absorbs a small percentage of the ray, along the line of the beam when the beam is being thrown for a long distance out of doors, as along the side of an airport. If an intruder walks across the beam, only the beam splitters between the intruder and the electric-eye receiver are affected, showing at once the exact area where the trespass occurred.

One clever use of the beam is to install an infrared system inside a vault where blueprints or other valuable papers are

2331

VITAL INDUSTRIES



Above, part of switchboard and fire-alarm system at Douglas factory

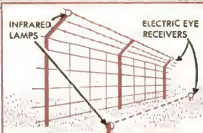


Above, Douglas factory police guarding restricted area where work on Army Air Corps planes is going on



kept, in cases where the vault must remain open for hours at a time for the convenience of employees. The invisible beam system is set up so that it automatically turns on a motion picture camera that runs for a short time after the beam has been broken. Employees who have authority to enter the vault make a hand signal after they enter which is recorded by the camera.

One of the hardest places in the world to enter, if you don't have bona fide business there, is the main plant of the Douglas Aircraft Company in Santa Monica, Calif., where more than \$300,000,000 worth of military air-



Above and left, how infrared rays and ray splitters help guard factory

Below, all Douglas employees must submit identifications at plant gates





Above, fire chief instructing employee dressed in asbestos clothing

planes are being built. Eighteen thousand employees walk in and out every day but a stranger can't. Each employee displays his badge and an identification card that contains his fingerprints and photograph to the guards at the gate, yet if a spy counterfeited a badge and card or stole them from an employee and tried to get in he would still be caught.

Below, demonstrating how to fight fire in office with carbon dioxide



Nerve center of the Douglas protection system is the combination police and fire headquarters that is connected to all parts of the plant and grounds by telephone systems, automatic alarms, and fire-alarm networks. Any guard can call in on a direct wire if he sees something out of the ordinary and the whole communication layout automatically switches over to a tamperproof emergency power source if the ordinary current fails.

The police force consists of 162 officers, all of whom have had previous military or civil



Above, high fences, searchlights and numerous guards protect plane plant

police experience. The force is twice as large as the average police department for a city of 100,000 people and even includes motorcycle police for escorting trucks that are hauling important or secret material from one plant to another. To join the force, an applicant has to pass tests much harder than the usual police requirements and he must be an unusually good marksman. In addition, the plant is under the scrutiny of Army and Navy representa-

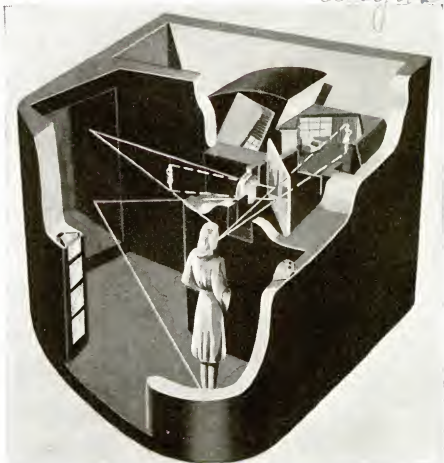
(Continued to page 189)

2450

*McFarland, Smith & Sons
Carter Co., 529-5th Ave*

Customer Views Self on Rug in Magic Display

To demonstrate what effect the colors of his rugs will have upon the individual purchaser, one large carpet manufacturer uses a magic-mirror display, built by Diorama Corporation, of Long Island City, N. Y., which permits the customer to view himself standing in the center of a room carpeted in various colors. At the same time a loud speaker explains the coloring of the rooms as they are shown in succession. The visitor stands in the bright light of a battery of lamps and peers through a small hole at a half-silvered mirror which combines a tiny image of himself with the diorama of a small room. His image is picked up by a mirror to his left and relayed to the "screen" through a reducing lens.



Customer sees herself standing on rug displayed by diorama. Mirror and lens combine her image with view of a room projected from drum at rear

Low-Cost House of Cotton Can Be Set Up in 62 Hours

To provide a market for surplus cotton as well as a low-cost, easily assembled

house for defense workers, a cottage that uses a large amount of cotton in its construction has been designed by the Department of Agriculture.



This cotton house provides a market for surplus cotton and also meets the need for a low-cost "dismountable" house to be used in defense work

A demonstration model, fabricated by the Speedwall Company, of Seattle, Wash., is a one-story structure 24 feet wide and 32 feet long, which can be erected in 62 hours. Both interior and exterior walls are of plywood covered with cotton fabric, which forms a base for paint or wallpaper. A total of 4,500 square feet of cotton is used. The house is demountable and may be knocked down and re-erected on another site when the need arises.

2 456

Army Truck Rides Cable Over River in Speed Trial



Special carriage picking up army truck and carrying it across river on cable bridge which was erected by army engineers at Fort Riley in three hours

Quickly building a cable bridge, instead of the pontoon variety, army engineers of Fort Riley, Kans., recently sent a seven-ton military truck across the Smoky Hill river three hours after construction was started. The truck was lifted in upright position by its wheels which were slung in "baskets" made of heavy ropes and chains.

to enable the U-boat commander to observe the shadow of a vessel directly above. The primary purpose of such a weapon would be to provide a defense against surface vessels dropping depth bombs, permitting the submarine to make a counterattack from below after it is forced to submerge. The bomb explodes on striking the ship.

Smaller Parachutes Are Made Safe by Cone in Center

Departing from the usual design, a new-type parachute, much smaller than those used today by the army and navy, has been invented by Dr. Christian Volf. It is claimed to be safer and easier to control, since it descends more slowly than other 'chutes. One new feature is a cone of silk inverted in the center of the umbrella forcing the air to flow into it at greater speed, thus retarding the fall.



Inventor bracing himself as he ground-tests small-size parachute. Note cone in center which forces air into 'chute to decrease speed of descent

Sub's 'Bubble Bomb' Fired at Vessel From Below

"Bubble torpedoes," that can be launched from a submerged position so they will strike the bottom of a vessel directly above, are reported to have been used recently by German submarines. A vertical tube would permit discharging the torpedo. A special underwater periscope is said

Associated Press News Photo Service

Chicago Tribune
April 1st.

L46 Maurice Deale Chief 100
Information Service, Knoxville, Tenn

Portable House Hauled in Sections by Trailers

As a result of studies made to work out the most economical method of housing workmen in comfort at temporary construction camps, the Tennessee Valley Authority has developed a portable cottage that may be taken down and moved in truck trailers. It is built in three sections, each of which consists of



Prebuilt section being lowered from trailer, above, will be bolted to other sections already in place



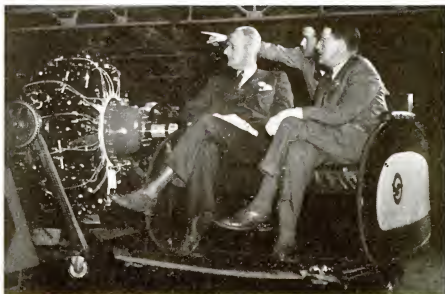
Finished cabin, left, needs only hooking up to electrical supply. Gangplank entrance fits any grade

one complete portion of the building, including floor, walls, ceilings and roof, with all electric wiring, light bulbs and plumbing installed, windows, screens and doors in place, and bathroom and kitchen fixtures, including electric cooking plate and refrigerator, already set up. A single section is 7½ feet wide, 22 feet long, 9½ feet high and weighs about three tons—a full load for one standard size trailer. Three

trailers are required to haul a complete cottage. The sections are fitted together with bolts, and four men can assemble them within four hours. Construction is wood frame with exterior of weatherproof fiberboard. In addition to a model consisting of a combination livingroom and bedroom, kitchen, bath, small bunkroom and screened porch, there is a larger duplex cottage. The latter has a central partition, each side containing a large room, kitchen and bath. Both are styled in modern lines with flat, overhanging roofs.

L376 "Electric Buggies" Carry Visitors Touring Engine Plant

Visitors now can sit at ease while they tour the long assembly lines producing Pratt and Whitney engines. The company has put into service three electric "doodle-bug" cars formerly used at New York World's Fair. Under the national defense program the plant, which builds engines for trainer, pursuit and bombing planes, has grown to such proportions that a tour on foot would require too much time and effort.



Officials and visitors tour engine plant in comfortable rolling chairs

Cub Warner Ogden 2519
Jefferson Cir. Knoxville, Tenn

JUMP OUT..

Top, cable from each trooper's parachute is clipped to static-line attachment in troop transport plane

Below, a parachutist leaving ship. The line will rip the top off his parachute pack in a fraction of a second



Now the 'chute has fully opened and it's up to the trooper to check his oscillation, or swing, and maneuver the "umbrella" to a safe landing spot. He must be careful not to close canopy in "steering" with shroud lines

AFTER the daily battle of the skies comes the British war communique, grim however you look at it. But the figures most important to a certain group of aviation scientists are those in the sentence reporting that, of a number of Royal Air Force planes shot down, "the pilots of five are safe."

From day to day the tally varies, the balance sheet of the lost and the lucky. What encourages the parachute technicians is the imposing record given in a recent R. A. F. summary. It showed that nearly 85 percent of the British flyers shot down had been saved by their 'chutes. Figures like these, covering the most adverse conditions of war, indicate the parachute makers have brought their science to a high level.

Just a few years ago the parachute was regarded with grave suspicion. James Floyd Smith, vice president of the Pioneer Parachute Company at Manchester, Conn., recalls that it was considered suicide to jump from a plane, for it was believed that the flyer would lose consciousness before the 'chute could open. Smith has

Carl. Emile C. Schürmayer
108 & 66 St., New York

the AIR is FINE !



Platform exercises at Ft. Benning, Ga., (top) are intended to accustom leg muscles to shock and train soldier to land on toes

Right, inspecting parachutes in the drying loft at Randolph Field. They are aired, checked and repacked every 60 days

Below, a 'chutist hits the ground neatly, still gripping the lines and holding them unsnarled



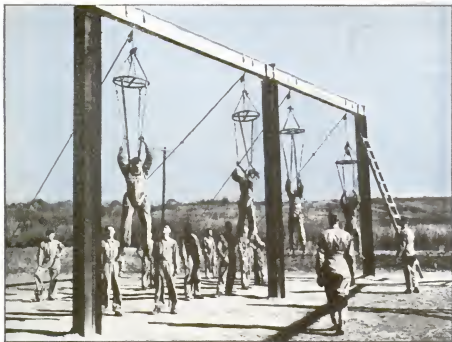
flown since 1912 and is the inventor of the ripcord type, manually operated parachute which is estimated to have saved over 10,000 lives.

"First a dependable 'chute had to be developed," he says, "then the pilots had to be convinced not only that the 'chutes would work, but that the free fall through the air would not cause loss of consciousness, or the shock of opening cause serious injury.

"Then, as planes became faster, the parachute had to be correspondingly improved. It must withstand the shock of a 200 pound load dropping at 300 miles an hour. And the pilot 'chute which releases the main 24-foot canopy must open away from the jumper so he cannot be fouled. With faster and faster planes predicted, constant improvements are being made."

An important step in this direction was the recent installation of a testing tower at Manchester, Conn., the first in America, to conduct parachute research under flying conditions.

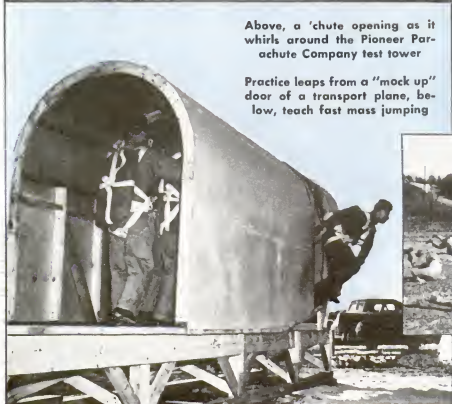
Staff Sgt. A. L. Buckner



Suspended in the "harness trainers," above, the aerial rookies learn the technique of manipulating the parachute to guide it during descent



Above, a 'chute opening as it whirls around the Pioneer Parachute Company test tower



Practice leaps from a "mock up" door of a transport plane, below, teach fast mass jumping

New ways of packing 'chutes and certain structural improvements already have been developed as a result of these tests.

From this 50-foot tower a dummy equipped with a parachute pack is whirled at 70 to 300 miles an hour. When the dummy attains the desired speed the parachute is automatically released, and 'chute and dummy float to earth. Meanwhile a motion picture camera, moving with the boom, takes a slow-motion record of the parachute opening. This has brought to light many important facts. In many cases, it showed the pilot 'chute, supposed to open first, was the last to operate. This hazard had to be eliminated, as it could foul the main canopy and lines. An improved pilot 'chute was developed and packing of the main canopy changed so that it is virtually impossible for the skirt of the canopy to be tilted up in opening, an occurrence that used to account for many parachute failures.

Spectators have seen exhibition jumpers step out of level-flying planes and descend gracefully



Tumbling and hardening exercises, above, prepare the air infantry for the shock of landing and getting on their feet quickly

beneath 28-foot exhibition canopies. "Leaping from a spinning, burning or diving plane hit by a shell or bullets from an enemy plane is quite another thing," says Mr. Smith. "To get clear of a plane in a situation like this, a self-contained parachute pack is essential. It is used by all the warring nations with the exception of German parachute troops, who use a static-line 'chute. This type is fastened to the plane by a cord which breaks under the weight of

Leaping from a spinning, burning or diving plane hit by a shell or bullets from an enemy plane is quite another thing," says Mr. Smith.



Top, Capt. W. T. Ryder, 501st Parachute Battalion, poises ready to leap from transport plane

The Marines are always ready to fight on land or sea. At left they try a new element, the air

Flying cadets at Randolph Field, below, take a lesson in manipulating the 24-foot "umbrella"



the jumper, pulling out the canopy. It permits a jump from very low altitude."

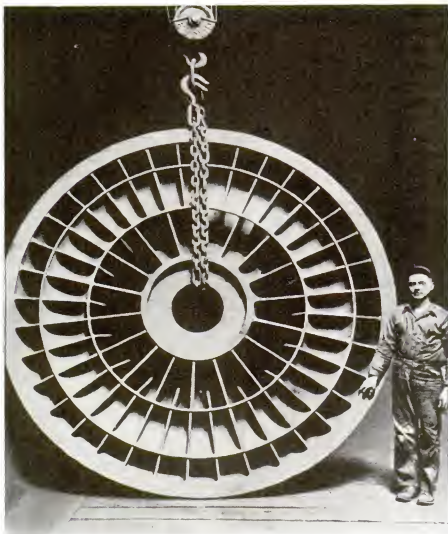
Static-line 'chutes were used by British pilots late in the World War and they were in use on that day in 1914 when Smith crashed a plane he was testing for Glenn Martin. He was flying at 1,500 feet when the right wing folded back, and he went into a spin. By adroit use of elevators, one good aileron and power he went into a power dive and pulled out a few feet above ground for a crash landing. Then and there he determined to develop a 'chute which would open when he jumped clear of a disabled plane.

(Continued to page 174)



*master Sgt.
C. F. Russell*

L432 Chrysler Corp., Dodge Ltd. Detroit *much* Super Fluid-Drive in Ship Takes Up Shock



Installed in a Diesel-powered ship to perform a function similar to that of an automobile unit, fluid-drive mechanism on a greatly enlarged scale absorbs in a bath of oil the abrupt drive variations caused by pitching of the vessel in rough seas that lifts the revolving propeller out of the water. Compared with the Dodge car's fluid drive, which is 13 inches in diameter and weighs 10 pounds, the gigantic marine gear has a diameter of nearly 10 feet and weighs more than 10,000 pounds. Fluid drives in both the car and ship also prevent the tendency of power plants to stall due to drive variations.

This is the rotor or driven member of big sister to the auto fluid drive to be installed in Diesel-powered ship

424 200-Acre 'Blackout' Plane Plant Blends Into Landscape

One of America's first "blackout" plants will be the \$12,000,000 factory of the Douglas Aircraft Company in California. Its 12 buildings will cover 200 acres, providing 1,400,000 square feet of working space under roof, and employ 16,000 workers. The plant will be windowless, fireproof and air-conditioned, and is to be painted to blend with the landscape. Utilities and essential materials will be housed in bombproof underground vaults.

At right is the storage section of the windowless Douglas Aircraft factory, which is to cover 200 acres and cost \$12,000,000



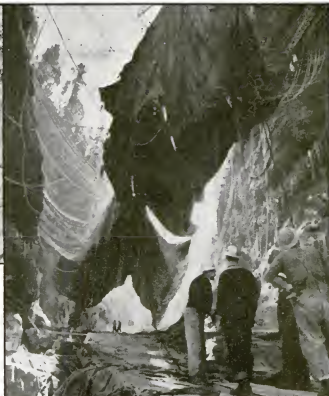
Acme
 POPULAR MECHANICS

L380 Cont. O'Brien Jacobson, 4725
53rd Ave. S. Seattle, Wash.

Huge Tent Shields Dam During Construction



Above, 35,000 pounds of canvas and ropes, ready to be raised. Right, rigging is started on its way up. Bottom, tent nears first level. Note gutters on wall



Ranking second in size to the largest circus tent, a "big top" was pitched to cover construction of the earth core forming the center of Mud Mountain Dam across the White River Canyon, near Enumclaw, Wash. To keep water from seeping through the dam, the earth fill must have a moisture content not less than 10 percent nor more than 17 percent during construction, and the purpose of the tent was to keep rain out of the mixture. A crew of 30 men, using 22 hoists, raised the canvas to its first position. At the top of the structure, the tent was planned to have a maximum spread of 196 feet in width, its length remaining constant at 328 feet. The dam itself will rise above the canyon rim to a total height of 425 feet from the river bed and will consist of a two-walled pyramid buttressed by rock. It will be 1,600 feet thick at the bottom and 50 feet thick at the top. To carry water away from the core, eaves of the tent were fastened to concrete gutters built on the canyon walls.

Latest Nonflammable Fabric Is Produced From Dried Seaweed

Seaweed has been added to the raw materials from which textiles can be manufactured, and the newest product is non-flammable, according to a report from England to the American Chemical Society. Alginic acid, which makes up about 20 to 30 percent of the dried seaweed, can be extracted, combined with inorganic material in the form of compounds called algi-

nates, and then spun through spinnerettes, like those used in making rayon, into a solution of acid. Without the addition of the inorganic material the fibers would dissolve in soap and soda solutions, and hence would be useless as textiles. It is said that the new fabric can be soaked in gasoline and the gasoline burned away, leaving the fabric unaffected.

JULY, 1941

Research by Prof. L. B. Speakman
for British firm Crompton & Co.
not ready for export

Seattle Tent
Crawling Co. Seattle, Wash.
Dam built by
L. B. Jacobson Co.
San Francisco, Calif.

Science Service 3/11/41

Detachable Parachute Pack Frees Pilot to Spin 'Prop'



Pilot wears harness, but leaves parachute pack on seat until he climbs into cockpit for the takeoff

Freedom of action to spin the propeller, fuel the plane or perform other tasks requiring ease of movement is afforded by a parachute pack which can be detached from its harness. The harness can be worn at all times without interfering with the pilot's work. Meanwhile the pack is left on the plane seat and attached at the time of takeoff. The adjustable harness can be fitted to anyone. The parachute is available in back or seat pack models.

Wire Coils Embedded in Shoe Sole Grip Slippery Surfaces

Shoes can be given better traction by fitting them with rubber soles and heels having wire coils embedded in parallel

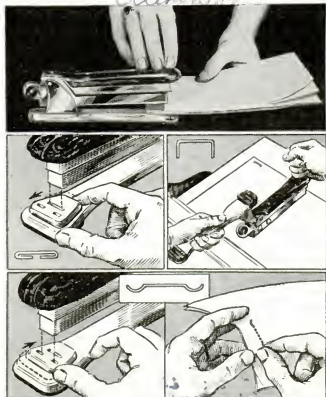


Built-in wire coils keep rubber sole from skidding

ridges extending lengthwise of the bottom. The idea was developed by D. E. Crooker, of Ontonagon, Mich., and is based on the principle incorporated in a nonskid ice tire which he invented. The coils are somewhat kinked, or corrugated, and have the outer edge protruding slightly through the base of the rubber sole so it makes contact with, and thus reduces tendency to slip on wet or icy surfaces. Eventually the exposed portion of the coil wears and the wires break, but this does not affect the antiskid qualities since it leaves countless points of wire projecting from the sole to grip the ground or pavement.

Four-Way Stapler Tacks, Pins Or Works Like Pliers

Four different operations can be performed with a hand-type stapler now available. Like the ordinary kind, it may be used on the desk to staple papers, or it can be picked up and worked like the



Top, desk stapler. Center, right, tacker; left, staple bent inward. Bottom, staple bent outward

plier-type for use on bags or wrappings. If a temporary fastening is desired, the staple points can be bent outward instead of inward so they may be removed as easily as a pin. The base is hinged so it will swing out of the way, permitting the machine to tack the staples straight into boxes or crates for attaching tags and labels.

POPULAR MECHANICS

ALL-AMERICAN SPORT



WHEN Bob Feller opened the 1940 season with a no-hit, no-run game, it was one of baseball's major sensations. Ever hear of Matt Rupert? Out of 200 games, Matt tallied exactly 100 no-hit, no-run victories. The feat won him no halo, however, for in softball the pitcher who can't fan 15 men to a game is no great shakes.

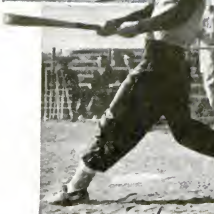
Why, there's a mid-west tosser named Burlingame who mowed down 21 batters in a row! That happens to be all the "outs" possible in softball, a seven-inning game. Lou Novikoff once struck out 19 out of 21 batters, and another time fanned 22 in an eight-inning tie playoff. A Cleveland girl pitcher, Mary Skorich, had 20 no-hit, no-run games to her credit at last reports.

The mighty Babe Ruth in his prime took three lusty swings at a softball once and missed them all a foot. On the other hand Novikoff, the \$100,000 outfielder who is playing

Safe! The runner makes a perfect slide, the baseman is out of position, and the umpire is putting on the brakes

Nab a sizzler like the drive being picked out of the sky at the left and you may wonder why they call it softball

Crack! The batter has lined one out in a Los Angeles game. There's good form—left side well braced, smooth swing and follow-through



JULY, 1941

*Cont. Lynn B. Lach, 1901 Thayer Ave
Los Angeles, Calif*



Here's how the star right-hander of a Los Angeles team dazzles the opposition. From top to bottom, Sammy Waxman's "in" grip and delivery; the grip for his smoking "fast one"; his "out curve," and the tantalizing slow ball. Try these out in your corner lot



Whatever the umpire called it, the camera calls it safe. The ball still has another inch to travel

his first major league baseball with the Chicago Cubs, slammed a softball 325 feet.

Softball a sissy game? Not so you'd notice it. Sure, they pitch underhanded and the old pellet is much larger than a baseball. But brother, it's harder to hit than Joe Louis. Out in Arizona there's a softball pitcher they call "Windmill" Watson, on account of his wind-up. When he lets one go from the box, batters say they'd have more chance of knocking down a clay pigeon. "Cannonball" Baker, Milwaukee, has a figure-8 delivery that generates so much steam he simply fogs them over.

Although softball is almost entirely an amateur game, it has its professionals. Novikoff is one. He plays softball in southern California during the winter and has been paid as much as \$75 a game. No pitcher in big-league baseball makes as much as "King Kong" Kelly, a vagabond softball twirler said to have earned \$45,000 in one year.

Although these are spectacular highlights of the game, its mass statistics are no less impressive. With everybody playing softball today—men, women and children—it is, unquestionably, the nation's number-one outdoor game. The Amateur Softball Association reckons that this spring some 200,000 teams took the field, each averaging 15 players. Scholastic, an educational magazine, puts the number of teams at 500,000 and estimates players at five million. In Los Angeles alone more than 500 games a week are scheduled during the summer, and some leagues function the year around. Softball spectator-totals for the nation are said to exceed

2-113

60,000,000 a year! This tremendous popularity has developed in a mere ten years, more particularly the last five. Back in 1900 they called it indoor baseball. Bases were only 20 feet apart, the ball so big and soft it wouldn't bounce. About 1910 it moved outdoors as a game for kids under such names as mushball, kittenball, diamond ball and playground ball. A tenth or "rover" player was added. Many softball teams today retain this tenth player, although nine-man teams are the rule.

Up to 1933, players made their own rules. There was no fixed distance between bases and balls varied in weight, circumference and liveliness. When the first na-



His road to home plate blocked, a runner (above) takes to the air to bring in a run safely

The crowd watching a night game at left is a sample of the 60,000,000 spectators estimated to attend softball games yearly

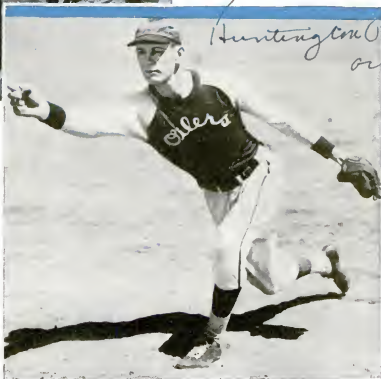
Below, Venn Botts, outstanding pitcher of a championship California team, demonstrates perfect delivery and follow-through



tional championship tournament was staged that year as a feature of the Century of Progress Exposition in Chicago, a special set of rules had to be drawn up hurriedly. About this time the Amateur Softball Association was formed and set about standardizing the game. Today a uniform brand of softball is played, with few sectional modifications.

For the benefit of those who have not taken up the sport, it

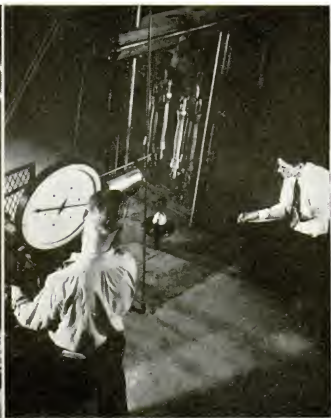
(Continued to page 172)



*Huntington Beach
Oilers*

JULY, 1941

of America, 237.6 E. 71st St. Chicago

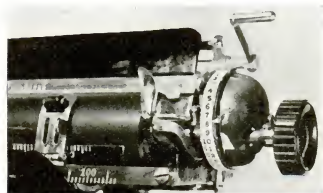


Two views show powerful pulling machine tugging at insulator coated with high-strength glass

Porcelain insulators, guarding the flow of electric power to defense industries, depend for much of their strength on "glass overcoats," or glazes, developed through many years of experience and research. The newest type glazes contract less than the porcelain body, thus reducing tension and enabling the insulators to endure the weight of long spans and the buffeting by storms. To test their resistance to breakage, the Westinghouse Porcelain Works at Derry, Pa., makes the insulators carry the brunt of a tug of war in a tension machine designed to pull things apart. The porcelain body, too, has come in for its share of

improvement under a process called Prestite that converts dampened clay into non-porous porcelain by molding the clay mixture in steel dies under high pressure. Compared with the product of the "wet process," this porcelain possesses better insulating qualities and one insulator can be turned out every three minutes as against the former rate of two or three a day per mold. This speed was evidenced in filling a recent order for 45,000 large size insulators required for a new high voltage system, when two Westinghouse plants together turned out 9,000 insulators—enough to fill two freight cars—per week.

Typewriter Last-Line Indicator Rings Bell at End of Sheet



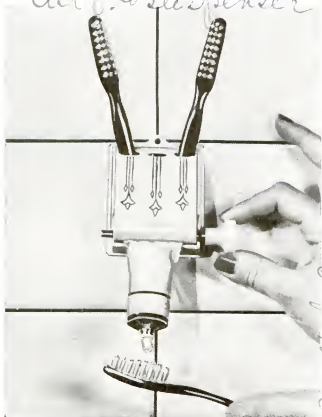
Numbered ring at right, sets the last-line indicator

Annoyance caused typists when they accidentally run too close to or beyond the bottom of a sheet, may be eliminated with the aid of a last line indicator patented by A. D. Thomas, of Fontana, Calif. This device rings a bell when the paper reaches any point as chosen by the typist, an indicator on a scale being set to point the number corresponding to the number of inches of paper which will be used when the last line is reached. For a standard size typewriter sheet, a one-inch margin will be left

at the bottom if the indicator is placed at number ten. Once set, it needs no further attention unless a change in paper size or depth of margin is desired. Geared to the platen shaft, the mechanism sounds the warning automatically when the last line is typed.

Dispenser Winds Up Tube as Toothpaste Is Squeezed Out

Easily mounted on the tile wall of the bathroom, a new toothpaste dispenser winds up the tube as fast as it is emptied. The dispenser is of plastic material, and has three holes at the top for toothbrushes. The tube of paste—or it may be shaving cream—is attached by a clamp at the bottom, and paste or cream is fed by turning a handle which squeezes the tube and winds it up.



Turning knob at right winds up tube, dispenses paste

Twelve-Ton Rolling Fortresses Stream Off Assembly Line



Inspecting a 12-ton tank as it leaves assembly line of American Car and Foundry Co. where part of Uncle Sam's mechanized army is in the making

Rolling along from the assembly line of American Car and Foundry Company plant at Berwick, Pa., is a steady stream of armored tanks. Weighing 12 tons, the little mobile fortresses, which are known as M2A4, will constitute an important defense arm in Uncle Sam's fast-growing army.

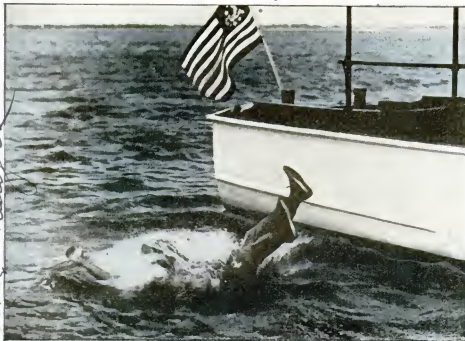
Book Marker Flush With Pages Keeps Place Automatically

Changing to the new place each time a page is turned, an automatic bookmark does not protrude beyond the edge of the pages and it does not obscure reading matter. Once clamped in the book it needs no further attention, yet reveals the correct place when the book is opened. It is clipped on the book by inserting a thin shaft between the back binding and the leaves, and placing the wire anchor down the middle of the reading section. A movable arm along the top of the pages is the place marker, and pages are passed under it as they are turned.



JULY, 1941

Gaineson Products 45
Blencoe, C. L.



Pictures will be remembered longer than words, so the safety men "staged" each phase of an accidental immersion for the camera. Above, the initial splash as a man falls overboard. The helmsman must immediately put the wheel over hard to swing the propeller away from the man in the water. Then (right) throw over a lifebuoy, or anything that will float, to mark the spot



Photos by The Texas Company

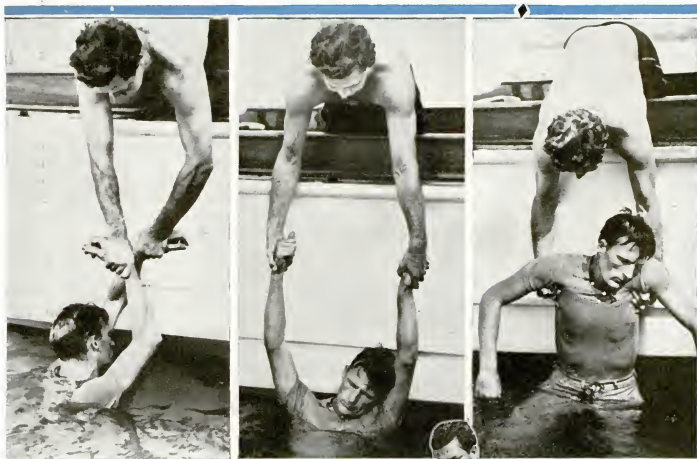
When the boat has been swung back to the site of the accident, a lifebuoy with a line attached may help bring the victim alongside. If it is necessary to swim to his aid, don't venture near him without a lifebelt no matter how good a swimmer you are. Finally, lifting a helpless man out of the water will be a difficult task and the technique of expert lifeguards may help. To begin, cross your arms as you lean down to grasp his wrists, as at left



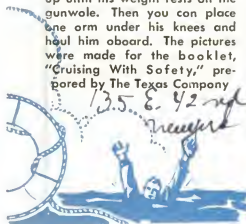
MAN

Among the hundreds of thousands who are spending vacation hours aboard small boats this summer, probably only a handful have given thought to what they'd do at the cry "Man overboard!" Yet danger of falling overboard from a small vessel at sea is always present. A study of these pictures, posed under direction of safety experts of an oil company, may save lives

OVERBOARD/



On this page are shown the successive stages of hoisting the helpless person aboard the boat. Starting with your arms crossed, you can swing the man, as you lift, so that his back is toward you. This will keep his legs from rising under the boat and take advantage of the buoyancy of the water; then lift him as high as you can and quickly grasp him under the arms. If he is quite unconscious and therefore limp, however, his arms will pull upward and your grip at the armpits will slip. Grasp him around the chest, clasp your hands together and draw him up until his weight rests on the gunwale. Then you can place one arm under his knees and haul him aboard. The pictures were made for the booklet, "Cruising With Safety," prepared by The Texas Company



L 362.

Pair of Tracks Spans Stream for Army Tanks



Narrow streams which normally would stymie army tanks are being crossed quickly by Fifth Engineers stationed at Fort Belvoir, Va. To overcome such obstacles they use two 600-pound grooved tracks of fabricated sheet steel which are laid parallel to span the ditch and spaced so the tank treads will ride squarely in the grooves.

L 334

Silencer for Planes And Tanks Makes Detection Difficult

Roaring exhaust noises of airplane and war-tank engines can be muffled to a point where they are extremely difficult to detect through sound, by using a suction silencer recently developed, according to Master Sergeant Frank Newton, an ordnance expert at Fort Rosecrans. He stated that other objects of the silencer are to purify the exhaust gases, thus rendering them harmless, and to reduce the back pressure in the engine's exhaust system.

Newspaper cut



acme

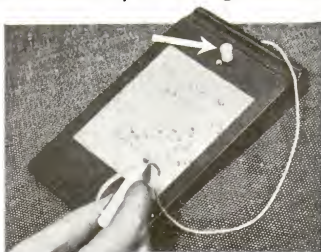
Knee-deep in water, army engineers at Fort Belvoir, Va., are shown at top erecting a new-type sheet-steel ramp which enables a tank to cross small streams. Bottom, the fabricated steel "bridge" is given a test

L 359

Handwriting on Magic Pad Is Erased by Pressing Button

Magic writing disappears at the pressure of a button from the face of a handy office memo pad, now on the market. The button also permits the message to be "locked" so it will not vanish until the button is released. The new pad uses the familiar method of writing with a blunt instrument on celluloid under which there is a thin sheet of paper and carbon. Refills for the pad are available.

Here is memo pad with magic surface. You make notes and then erase them by pushing button when no longer needed. Button also "locks" writing if desired



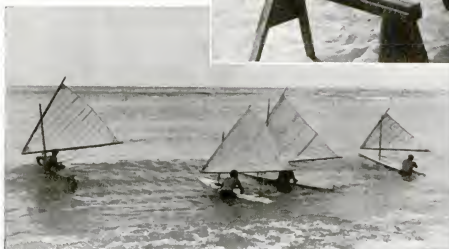
2384 Cmr. Richard M. Bots, 2056 Lanikuli Drive Honolulu, Hawaii

Surf Riders Find Thrills in Sailboard Races

Sailing surfboards, an exciting water sport now becoming popular in California, has seen a rapid growth from the crude board, used originally in Hawaii, which would sail only with the wind but not against it, to the maneuverable streamline craft of today. Many of the boards raced on figure-eight courses at Wai-kiki are approximately



Sailing surfboard, above, is hollow and may be dismantled for use without sail. Note "hiking" board in the center



Left, lining up the boards for a race around figure-eight course which is approximately two miles from start to finish

11½ feet long and equipped with large sails. The rudder is worked with the feet, leaving the hands free to manipulate the sail, and a large, lightweight keel helps keep the board from sideslipping. The latest development is a "hiking" board extending over both sides of the board into

the water, on which the rider leans his weight to keep the board from overturning. Those who have mastered the art of surfboard sailing say that the boards create an effect of great speed, since the surfer lies flat on his stomach and is almost level with the surface of the water.

Glasses Help Golfer Obey Rule to Keep Eyes on the Ball

Every golfer knows that the first rule of the game is to keep your eyes on the ball,

but many violate the rule without knowing they do. Amber-colored glasses now on the market signal the player if he turns his head during the swing. This is accomplished by a tiny triangular cutout at the lower lefthand corner of each lens. As his swing is started the golfer tilts his head so the ball appears white through the triangles, and holds that position until the stroke is completed. Should the head jerk or turn even slightly, the ball appears to change in color because it would then be viewed through the amber lens. The glasses may be worn to advantage on the tee, on the fairway, in sand traps and on the putting green.

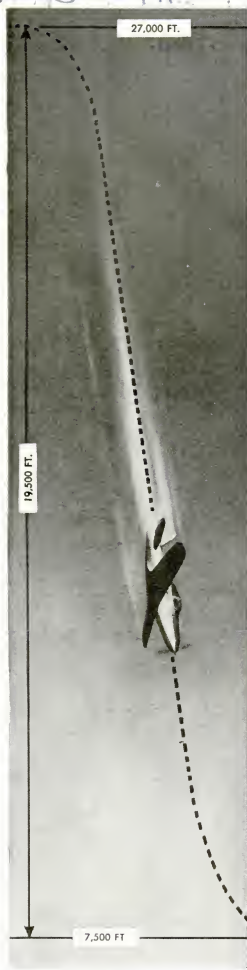


Golfer will not fail to keep his eyes on the ball if he sights it through lens triangles during the swing

JULY, 1941

Chicago Eye Shield Co
2300 W. Arden Ave. Chicago

2413



Here's how the Airacobra dropped faster than a bullet in a dive from 27,000 feet to 7,500 feet, a total descent of 19,500 feet, to set a new record

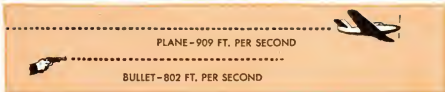


I FLEW



Servicing the Airacobra's armament, which includes a 37 mm. cannon that fires through the hollow hub of the propeller (see arrow)

Below, comparing Airacobra's diving speed with speed of a bullet



By Andrew Charles McDonough

Eastern Air Lines Pilot

Municipal Airport, Atlanta, Ga.
I HAVE traveled faster than any man on earth, and above it—620 miles an hour, almost 75 miles per hour faster than a bullet fired from a .45 caliber automatic pistol. My adventure in super-speed happened while I was dive-testing a Bell P-39, the Airacobra, on a sort of "busman's holiday" from my job as a commercial air line pilot.

Because no special preparation had been made, it was a complete surprise when I was told long after landing that I had set a record, hitting a pace of 909 feet a second. There were no extraordinary sensations to tell me that this dive was any faster than others I had made. As I rode along with the plane's

2000 Bell Aircraft Corp.
Elmira, N.Y. Buffalo, N.Y.

FASTER *than a* BULLET

nose pointed to earth, I felt no different than I did on level keel. The ride was better than you can get in a jalopy on the ground at 50 miles an hour. Not until I pulled out of the dive did I realize how fast I was going, and even then it wasn't so bad. When I pulled out, it was as though I suddenly had sat down hard on the floor, or, maybe, like I had been kicked by a mule, but not so sudden.

And after it was all over, and I found out how fast the P-39 had dived without help from its powerful engine, I wondered what would have happened if I could have fired a pistol back over the tail, or if I could have fired it ahead and parallel to the plane's course. Since I was traveling 107 feet per second faster than a .45 caliber bullet moves when first discharged, would the bullet have rolled out of the barrel and fallen straight down, or would it have stayed in the barrel, or what?

Dive-testing planes was not new to me. After all, I had run many tests on planes during my two years

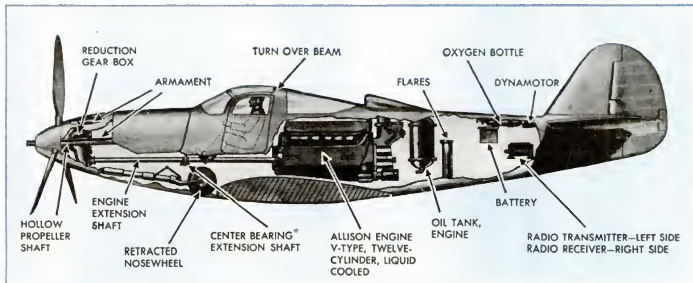


Above is the writer, Pilot Andrew Charles McDonough, at controls of Eastern Air Lines plane. He says his record dive was not accompanied by any extraordinary sensations of speed

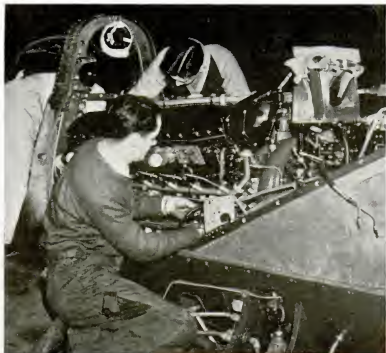


And this is the Airacobra in the air. Note the long tapered nose and the stubby wings

Below, cutaway drawing of the fighting plane. Note how long drive shaft connects prop and engine



2413



Above, servicing the big 12-cylinder, 1,150 horsepower Allison engine

Right, another view of the trim plane as it appears while flying



Below, pilot faces this multiplicity of instruments and gun controls when he starts aloft in the Airacobra



at the U. S. Navy's flying station at Pensacola. So when the chief engineer of the Bell Aircraft Corporation asked me if I would test the P-39, I said: "Count me in!" and I obtained a brief leave of absence from my regular job.

Test-flying an airplane of a brand new design is something like breaking in a horse. You learn all you can about the critter before you assay that real test to determine whether it or you are the boss. In case of the airplane, you find out all you can about the airplane by talking with the designer and the engineers who created it; what flight characteristics

are likely to be dominant and why. When, at last, you have absorbed all of the technical background on the craft you need, you slip into the cockpit, and take off for a brief flight. You climb and ease it through fundamental maneuvers, feeling out the controls and acquiring confidence in the plane to do the job for which it was built. During this process, dives at comparatively low speeds may be performed to determine the plane's flight characteristics. This process may go on for several days until you feel that you understand the plane completely and that it understands you. By this time you are so intimately acquainted with your craft that, indeed, you have come to believe yourself a part of it. (And, by the way, this is not exaggeration. No pilot ever achieved anything in precision flying without attaining this relationship between himself and his

2413
craft.) That is just what I did with the P-39 the day of the final test flight.

As I walked onto the field the Airacobra was being warmed up. A trim, stubby winged little plane with a long tapered nose mounting a three-blade Curtiss electric propeller, it is powered by a 12-cylinder, 1,150-horsepower Allison Prestone cooled engine placed at the rear of the pilot's compartment. The propeller operates off a long drive shaft which extends from the engine, below the pilot, to the propeller gear box. In the nose are the deadly stingers of the Airacobra, a 37 mm. explosive shell firing cannon and two .50 caliber machine guns; in the wings are mounted four .30 caliber machine guns. This is the interceptor pursuit plane which packs a withering fire in addition to its phenomenal speed and maneuverability. The Airacobra carried a full military load in all respects during the tests. This was not a test on the engine but rather on the plane to determine its ruggedness at maximum dive speed.

I climbed, climbed, climbed. The ice cream clouds spread a vast blanket separating me from the earth, reminding me that I could thank my cabin's efficient heating system for the comfort I was enjoying. At 14,000 feet I put on the oxygen mask, for I was going even higher. I continued circling and climbing until I reached 27,000 feet; then reached back over my head and turned a switch in a box there. The box contained a fixed-focus motion picture camera trained on the faces of the altimeter, airspeed indicator, clock, thermometer and many other instruments.

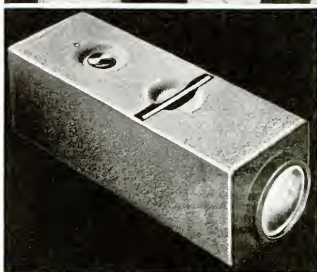
I called the ground crew:—"Will now dive from West to East"—and adjusted the controls changing over from level flight to dive. This was not to be a power dive, with the big engine going full blast. Instead it was a "free" dive, with the propeller turning just fast enough to keep the engine warm.

Now, for the real test! Stick forward, and I fell easily into the dive. My sensation was, at first, one of falling into a pit. Then I began feeling that I was falling right with the ship, as though suspended in space. The wind screamed around the gun barrels protruding from the nose cowl. Higher, higher, higher the scream rose, finally attaining a steady pitch. Soon my ears grew accustomed to the sound; I

(Continued to page 170)

JULY, 1941

Color Transparency Viewer Uses Battery Light



Color transparencies are illuminated and enlarged in this simple viewer that brings out their beauty

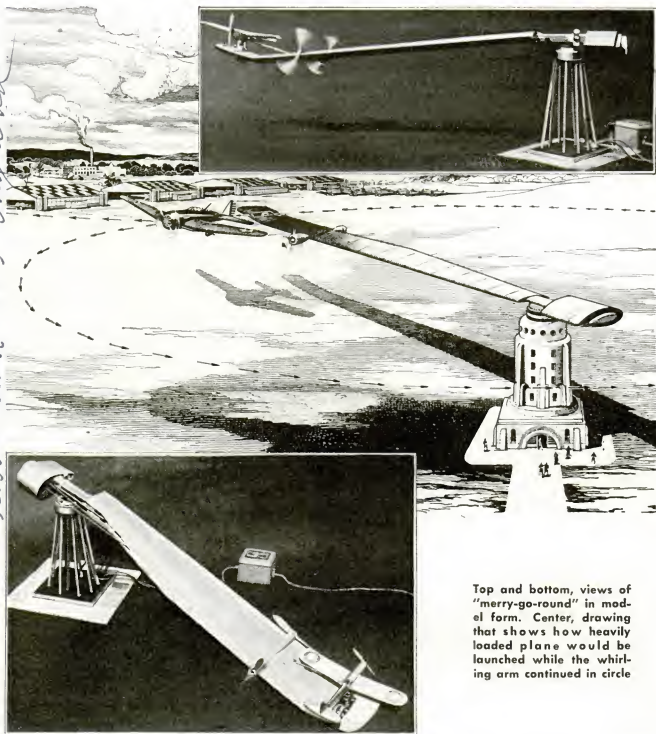
Viewing Kodachrome color transparencies is simplified by a compact illuminated box in which the slides are viewed directly instead of being projected on a screen. It is only necessary to press the switch, insert a slide and hold the viewing lens to one eye. The result is a brilliant view of the picture, which appears greatly enlarged. The box itself, finished in attractive gray, is about 2½ inches square and 6¼ inches long, with a slot that accommodates two-by-two inch color slides. Spring clips keep slides from falling out. Light comes from a standard flashlight bulb and two batteries, which may be replaced when necessary, furnish the current.

For each locomotive in service, there are approximately 23 railroad employees.

*Allan's Audio
Publicity*

L 391

"Merry-Go-Round" Arm May Launch Planes



Top and bottom, views of "merry-go-round" in model form. Center, drawing that shows how heavily loaded plane would be launched while the whirling arm continued in circle

Launching of heavily loaded bombing planes by means of a captive arm or wing has been proposed by an English inventor, P. B. Shead. The device would whirl the plane around and around until it attained sufficient speed to be released into the air. The wing would be driven by powerful gasoline engines and propellers. When not in use the outer end of the wing would touch the ground. A plane ready to be launched would be fastened to this outer end and its engines, with those on the wing, started to swing the wing around.

At the proper speed, the plane would be freed, with centrifugal force helping to give it a good start. A model of the launching "merry-go-round" built by the inventor indicates that the wing is designed to give the correct angle for the plane's speed and radius of turn, thus avoiding complications resulting from an aircraft being flung off at a tangent, instead of heading into the wind. The cradle in which the plane rests on the wing is close to the ground, when the arm is at rest, making it possible to load planes easily.

Flight Pub Co. Ltd. 100, Horse, Stamford
St. London, S.E.1, England

Junior pomologist

2414... Mich. Assoc. of Hort. Ex. Com. Ohio

Rubber Veil Protects Blossoms From Insects

Protection of blossoms from insect attacks and foreign pollens has always been a problem of the plant breeder. In the latest solution to that problem, the plant scientist has borrowed an idea from the movie industry. J. R. King, fruit breeding expert of the University of California college of agriculture, saw a movie in which lifelike spider webs were woven of rubber cement and conceived the idea of spinning such a web around fruit blossoms, after pollenization. The B. F. Goodrich company collaborated with him in developing a rubber cement that would keep out insects, would not injure the flower and would resist wind, rain and sun. To spin the web around the flower, the cement is driven by centrifugal force through two lips of a whirling cen-

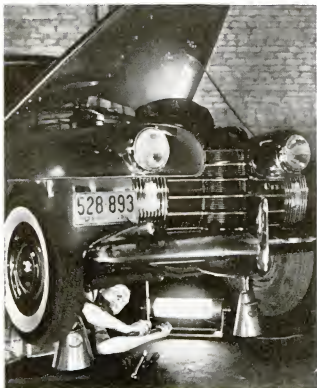


Directing fan, the operator weaves rubber strands around fruit blossoms

trifuge cup mounted on the shaft of an electric motor. A fan blows the strands around the branch as the operator directs it.

2304.

Fluorescent Lamp on Tool Tray Gives Cool Work-Light



Advantages of a portable fluorescent light are offered servicemen and repairmen in a small-size rolling unit that provides a tool tray as well as the lamp. For close work, as under automobiles, the light gives comfort since it is cool and eliminates glare and shadows. It consists of two 15-watt replaceable fluorescent bulbs mounted behind an unbreakable plastic lens that resists water, oil and grease. Another portable fluorescent lamp for workmen is equipped for suspension by hooks.

THOUSANDS USE WHERE-TO-BUY-IT INDEX

Thousands of readers are using our new Where-to-Buy-It Index. Have you tried it yet? Next time you want more information about a product described in Popular Mechanics Magazine, just note the page on which it appears, then turn to the Where-to-Buy-It Index starting on page 4-A, and if the product is on the market you will find the name of its maker or distributor. Write directly to the firm listed, and to get quick action—Say You Saw It in Popular Mechanics.

Tool tray carries fluorescent lamp under automobile

JULY, 1941

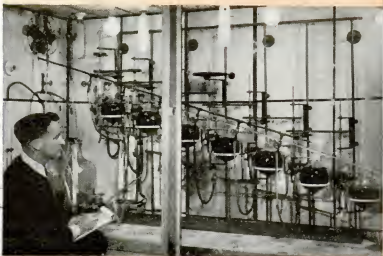
Gray mfg. & Supply Corp. 55
3107 Pine St. Phila. Pa.

Post Cmt. Thomas E. Stinson Jr.
3872 Franklin Ave. Los Angeles

Have you IDLE HORSES



Exhaust-gas analyzer which aids in tuning carburetor to proper air-fuel mixture



Miniature fractionation plant that duplicates performance of petroleum refinery
Below, blower creates blast of air against radiator to simulate road conditions



YOU paid around \$10 apiece for the "horses" in your new automobile and if you are an average driver you retired some of them to pasture after a few thousand miles. Some of the horsepower under your hood is consuming gasoline and not doing any work.

One estimate is that California motorists alone are feeding 10,000,000 horses that were built into their cars and that are now on the sick list. The power being wasted by American motorists amounts to the output of some 60 Boulder Dams. Your car will go farther on a gallon of gas when you put all your horses back to work.

Out of 100 cars picked at random off the street, 60 were improved from 1 to 10 percent by a good tune-up, and the other 40, including some new cars, were improved from 11 to 60 percent.

A couple of years ago, when you wanted a tune-up, a mechanic drove your car around the block to "trouble shoot" it, made a few adjustments, road-tested it again,



Projector helps show fluctuations in carburetor adjustment

under YOUR HOOD ?



Checking engine's ignition and electrical system with latest equipment. Proper operation helps to attain economy and power

Below, connecting engine to a dynamometer for test of horsepower

and kept after it until the motor sounded right. But he probably didn't tune it to peak efficiency.

Today, in an increasing number of garages, you drive your car onto the rollers of a chassis dynamometer and sit there while the mechanic idles the motor, steps on the throttle, and then races it at full speed. In five minutes or so he tells you: "Your air cleaner is dirty, the spark plugs need adjusting, and you need a new condenser. Incidentally your speedometer is five miles fast." After the adjustments are made you watch the horsepower needle on the dynamometer board creep way past





Cold laboratory for studying performance of oils and gasolines under winter conditions. Note heavy clothing workers must wear

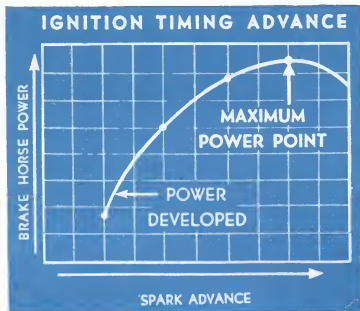


Chart shows maximum power is developed when spark is advanced almost to detonation point

the mark it made before. Twelve horses that were eating their heads off under your hood are back at work.

The garage didn't install the dynamometer to save time but because modern engines are so complex that few mechanics can tune them to peak efficiency without help. The dynamometer literally builds a road under the car and for the first time a mechanic can trouble-shoot and adjust an engine at 60 miles an hour or while it is climbing a steep hill, all without leaving

the garage floor. Do you want economy? Ninety-nine percent of motorists howl for it but few do anything about it. The first thing to do is have your engine tuned for full power instead of maximum economy. That sounds foolish at first but power and economy really go hand in hand. When the carburetor is leaned down below its maximum power setting you have to step on the throttle harder to maintain speed. To maintain 55 miles per hour in still air on a level road the engine of the average car has to produce 23 horsepower and

when the engine is properly tuned you get the power at a reduced throttle opening.

It's true that some of the cars built in 1937 and earlier, burn richer mixtures than they should. In these cases you can lean the carburetors down with economy metering jets supplied by the factory but you shouldn't do

Photographing carbon deposits in combustion chamber as part of research on pre-ignition

Courtesy Union Oil Co. of Calif.



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this with more modern cars unless you live in Denver or some other high-altitude area where you not only need a leaner fuel mixture but one of the optional high-compression heads as well, to get the maximum power out of your engine.

"Your engine should be tailor-tuned to your altitude and the grade of gasoline you habitually use," explains Fred B. Ross, technical expert of the Automobile Club of Southern California. "Aside from that, fuel economy depends on the way you drive. You can save some gas as well as increase the life of your tires by inflating them a few pounds higher than the recommended pressures, although you'll get a rougher ride and will be more apt to skid on slippery pavement."

You won't get maximum power out of a luke-warm engine, hence you should keep the radiator water temperature up between 160 and 175 degrees. With the engine idling after a run, hold a thermometer in the radiator water and if the temperature is down around 140 or 150 degrees, cover a part of the radiator.

You won't get peak efficiency if the spark plugs are of the wrong grade for the conditions under which you drive. Take them out and inspect them several thousand miles after they were last changed or cleaned. If they have grey-white or blistered porcelains they are running too hot and you should use a cooler plug. If they are black you want a hotter grade. If they are chocolate brown, put them back because that's the way they should look.

If your car is a 1940 or 1941 model you may be having pre-ignition trouble. In some cases it is so bad that the engine will continue to run and you can drive through traffic with the ignition switch off. Change to a fuel of higher octane rating, or try using different brands of gasoline until you find one that doesn't pre-ignite. Gasoline experts still do not know why different brands of gasoline, all made to the same specifications, have different pre-ignition characteristics, and they have gone to work on the problem.

The best remedy for pre-ignition is to remove the engine head and file and polish away all possible hot spots in the combustion chambers. Every speck of carbon must be removed. All surfaces must be polished smooth and every sharp corner of metal must be ground down. This applies espe-

(Continued to page 183)

JULY, 1941

2335

Ready-Made Stock 'Pillory' Easy to Install



Above, pulling lever catches a hog as it ventures through passage; below, reverse push releases it

Hogs and other livestock can be caught with a "pillory" now on the market for easy installation in a runway, chute, gate or doorway through which the animals pass. The trap is closed quickly about the animal's neck as soon as its head is poked through, and it can be held for testing and treatments. The trap will snare little or big animals without readjustment. It is designed to save the time required of the farmer building his own.

Census figures indicate that registered hospitals throughout the country have 1,226,245 beds available, enough for about one out of every hundred persons.

Science Service
3/13/41

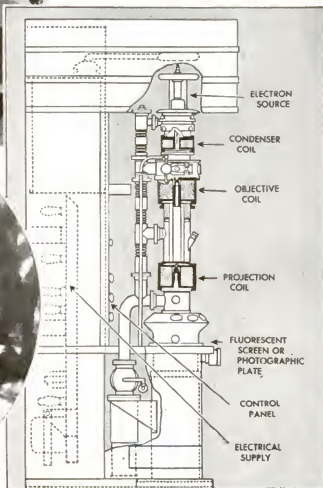
Super-Microscope Explores Invisible World

New facts concerning deadly disease germs and other infinitesimally small particles are being uncovered almost daily by scientists utilizing the electron microscope developed by the RCA research laboratories at Camden, N. J. This instrument permits useful magnifications up to 100,000 times, 20 to 50 times more than is possible with ordinary microscopes, thus enabling

man to peer into a world invisible heretofore. With this super-microscope, Dr. Wendell M. Stanley of the Rockefeller Institute for Medical Research has made studies which indicate that it may be possible to watch invisible viruses at work. Dr. Stanley has isolated the virus which causes mosaic disease of tobacco plants and found it to be not only a disease germ but a crystalline chemical. In this work, Dr. Stanley and an associate were able to follow the interaction of tobacco mosaic virus molecules with certain smaller molecules, which is like seeing disease viruses at work. If scientists can see far enough in this way, they might be able to follow the chemical process by which a cancer-causing virus, if it exists in the body's cells in a latent or masked form, is stirred into action.

Important chemical changes that

Left, electron microscope in use. Bottom, left, elementary fibers that make up soap as they appear under magnification of 45,000. Right, diagram of microscope's essential parts



278 493

take place in a diphtheria germ also have been revealed with the aid of the new instrument. It has been found that the germ absorbs chemicals such as dissolved salts as do large living organisms. For example, potassium tellurite diffuses into the diphtheria germ and when inside is reduced to metallic tellurium in crystal form. Bacteria of certain kinds have been shown by the enormous magnification of the electron microscope to possess solid cell membranes surrounding the fluid protoplasm of their bodies and serving as protective armor. Outer shells have been found on streptococci, pneumococci, bacillus subtilis (the common hay bacillus), coliform and typhoid bacilli. Two types of bacteria have been found equipped with long, apparently tubular movable arms, called flagella, which help them move about.

If a human hair could be subjected to magnification of the super-microscope, it would appear as large as California's giant trees, as wide as many city streets, and as thick as a water tank 40 feet across. A dime thus magnified would appear to be more than a mile in diameter.

In the industrial field, the American Cyanamid Company is using the electron microscope in an effort to uncover new and important facts about the action of catalysts, which so mysteriously promote chemical reactions. The company also plans to apply the instrument in the manufacture of special chemicals used in the leather and paper industries; the treatment of textiles; rubber chemicals and their action in prolonging the useful life of rubber goods; and synthetic resins, as well as the plastics and enamels into which they enter. Insecticides and fungicides, fertilizers and plant hormone substances and other chemical products also will be studied.

James Hillier, who is a co-developer of the new instrument with Dr. V. K. Zworykin, associate director of the RCA research laboratories, explains that the microscope utilizes a beam of swift-moving electrons focused by electromagnetic "lenses" to produce images of minute objects on a fluorescent screen (like those used in television) or on a photographic plate.

In comparison with the first electron microscope, which required a roomful of power-supply equipment for its operation, a smaller commercial model is so simple that it is ready for operation when plugged into an ordinary light socket.

Infrared 'Blackout' Camera Hides Flash Behind Filter



Invisible flashlight behind infrared filter (top) furnished the only light for the snapshot of cat

Firing a flashlight bulb inside a light-tight reflector, a Minneapolis newspaper photographer takes action pictures by the unseen light piercing an infrared filter. The "blackout camera" was developed by George Luxton, chief photographer of the Minneapolis Star Journal, after a London cameraman had flashed a picture of Wendell Willkie and John Cowles, Star Journal publisher, during the blackout. Using infrared-sensitive plates or films in the camera, he placed an infrared filter in front of the flash bulb of his synchronized flashgun reflector. The bulb was housed so that no light could escape except the invisible rays which passed through the filter.

Minneapolis Star Journal

205 Cmt. Allen Warren Elliott
343 E 33rd Street
TWO-IN-ONE FURNITURE

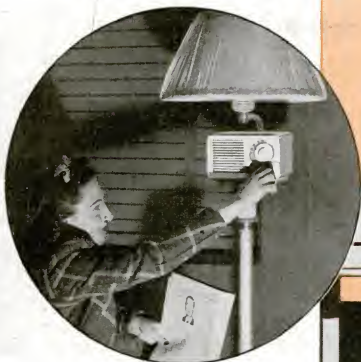


In these days of compact living, of apartments and trailers and housing projects and bungalow villages for defense workers, it's not enough that a chair be simply a chair and a lamp only a lamp. Furniture must lead a double life. Look, for example, at that twin sofa above. By night it resolves itself into a single bed, twin beds or double bed, as you like. And that plastic-bound plywood boudoir set at left—fold down the mirror and it becomes a desk



Ordinarily you'd call that comfortable-looking dual piece at the left a chaise longue or chair-ottoman. But when company comes, lift the top of the ottoman and lo, there are two chairs. Designed for tiny modern apartments is the Groye and even perched atop a refrigerator, above

SAVES SPACE



Perched in a little place of its own in the lamp standard (above), the radio can be turned on and off without rising from a comfortable easy chair. Both the radio and the lamp standard are of molded plastics



Drop the hinged front of the table, above, and an ironing board comes out of hiding. Triple socket at the woman's fingertips connects the iron and perhaps a percolator



With an elegant false front that gives it a lowboy effect, the cedar chest (above) becomes a decorative livingroom piece

You'd never guess the chair at right makes a full-size single bed. The extending back folds flat against the cushion and a cover matching the upholstery conceals it



JULY, 1941

Eclipse-Sleep Products Co.
206 Lexington Ave New York

2299

Chicago Daily News
3/26/41

Bike Couriers Hurry Meals To Remote Defense Crews



These men use bicycles to carry food and beverages to London's defenders. Boxes are mounted over the small front wheels

As most of the balloon barrage anchorages in the vicinity of London are located at points where it is impossible for crew members to do their own cooking, food is prepared at a central kitchen and transported to the men by cyclists. Meat, vegetables and sweets sufficient for a single crew are packed into a cubical box mounted over the small front wheel of the bicycle and delivered 2 to 10 miles away.

Fading of Bursting Star Recorded 6,000 Years After Explosion

Using the 100-inch telescope on Mount Wilson, astronomers have uncovered evidence that completes the history of the explosion of a star, the greatest known cataclysm in the universe. The explosion occurred, it is estimated, about 6,000 years ago, but was first noticed on earth in the year 1054 A.D., due to the fact that the star was so far away its light traveled 30,000,000,000,000 miles over a period of 5,000 years before becoming visible. Old Chinese and Japanese records are the authority for the date of its first visibility on earth. At that time the brilliancy of the

explosion was comparable to the light given off by the planet Jupiter, as seen from the earth, and probably equalled the light of several hundred million suns. Today the star has collapsed and is only a white dwarf. The Mount Wilson finding was made by pointing the huge telescope at what is left of the star and recording its spectrum. Astronomers estimate that the star's explosion was so great that gas clouds from it have been expanding for nearly 900 years at a speed of 800 miles per second.

"Walk and Wait" Lights Control Pedestrians

Pedestrian traffic lights embedded in sidewalk curbs at busy street intersections have been installed at Montgomery, Ala. The signs are synchronized with the overhead vehicle stop-and-go lights and flash alternately the words "walk" and "wait" formed by Neon tubes. Both the top surface and facade of the curbing are illuminated so they are visible to persons approaching from either the sidewalk or street. The unit is housed in a metal container recessed in the curbing.



Here pedestrian halts at "wait" sign. When the word changes to "walk," he can cross intersection safely

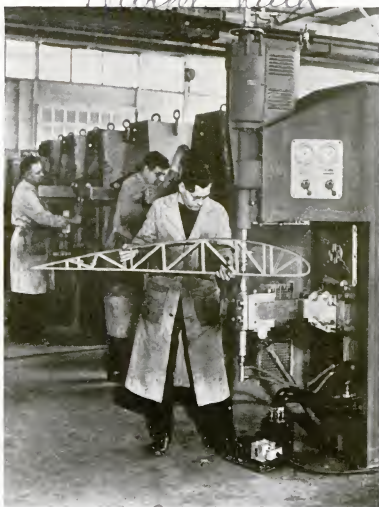
Walpole C. Bus
Montgomery, Ala.

Mr. Rudolph L. Minkowski
Pasadena, Calif.

L392 Progressive Welder
3050 E. Outer Blvd.
Milwaukee, Wis.

Aluminum Welder Speeds Plane Fabrication

Production of airplanes may be speeded up by a new ultrafast machine for welding aluminum sheets. Tests on duralumin strips like those used in airplane fuselages produced a spot weld of double the strength required by the government for rivets, taking just 1/300 second for the weld. The manufacturers assert the machine could replace with welds virtually all the 450,000 rivets that go into a four-engined "flying fortress" and that the time for building one of these big bombers might be cut in half. The weld is accomplished by a "pulsating" direct current of 25,000 amperes, at seven volts.



Tests on duralumin strips indicate the machine at right can produce a satisfactory weld in 1/300 second. Its adoption in airplane manufacture might reduce greatly the construction time

L297

Art School Teaches Color Camouflage for War Defense



Art director pointing out to a group of students some of the tricks in using a maze of colors and designs to conceal plants from air raiders

Anticipating a possible future need for many experts in the art of camouflage, the Mainzinger Art School, at Detroit, Mich., is teaching students how color may be used effectively to conceal ground objects from enemy flyers in wartime. Pupils learn how to create serpentine outlines and fill the spaces with a maze of hues in order to conceal factories.

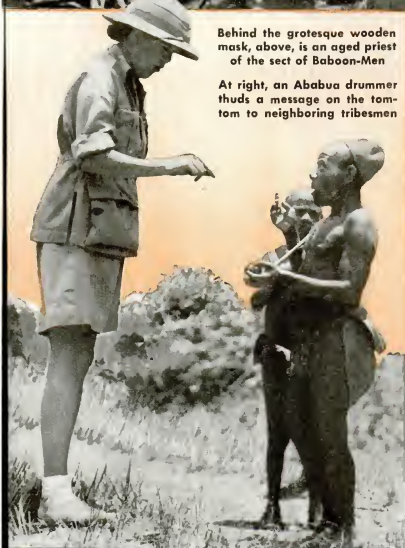
❶ In one cubic mile of ocean water there are 128,284,403 tons of common salt, 17,946,522 tons of magnesium chloride, 358,270 tons of magnesium bromide, 1,400 tons of fluorine, 90 tons of iodine and many other solids.

TRAILER-BLAZING



Behind the grotesque wooden mask, above, is an aged priest of the sect of Baboon-Men

At right, an Ababua drummer thuds a message on the tomtom to neighboring tribesmen



Part II

By Commander Attilio Gatti

9630th St., New York
IN THE motionless shade of an ever-green matooba tree, the temperature is 104° Fahrenheit. How much hotter it is in the full blast of the equatorial sun, no self-respecting thermometer would care to record.

Yet Dominick, the usual unlighted cigarette dangling from his mouth, doesn't make one effort to get out of that glaring heat. Naturally not. He is only a dummy, built of sacking and straw and dressed like an Arab to act as a double in a scene we were to shoot of a cruel slave trader thrown down a precipice by rebellious slaves. When the scene was deleted, he remained; and Charlie used to sit him in

These Mambuti pygmies are shy little fellows but make faithful friends. They helped track the okapi

through the AFRICAN JUNGLES



Dominick, at the center of a circle of excited natives, was only a stuffed shirt but he brought us plenty of trouble
Below, an okapi, "living fossil" and cousin of the giraffe

a prominent position in every new camp. Natives would flock in to stare at our trailers, to offer wood and water, chickens, eggs, fruits, whatever else we needed. When they discovered Dominick, there would be shouts of half-frightened, half-amused astonishment.

The farther we went from Stanleyville, however, the more was their fright, and visitors and supplies constantly diminished. Yesterday, putting up this camp in sight of a big village, we didn't see one native, and I began to worry.

I sent a boy to the village with a message for the Chief. He found the village deserted, although red embers showed the huts had been abandoned only a few hours. I rushed Charlie in the station wagon to fetch the Territorial Administrator from his post a hundred miles north.

Two anxious days later the Ad-



R142a



It took some time for the Ababuas to get used to the noise of our radio, the recorder—and to the mysterious Dominick



Preparing to take the jungle trail, we fasten snake-bite kits to every man's belt

ministrator arrived, greeted us, then stopped abruptly in front of the dummy.

"Ah!" he said, with a grave face.

Then the story came out. During recent years, among these Ababuas, there have been many violent deaths and mysterious disappearances. Some victims have been found, horribly lacerated by the leopard's claws, as the white authorities thought; or, as the natives believed, by the

Violent deaths among natives were blamed on the claws of a leopard-man



Lower left, Ababuas flocked to camp bringing eggs, fruit, chickens, water

At right, below, is a herd of mzei—smallest and most vicious of elephants

claws of a leopard-man.

One day a planter, one of the two white men living in the territory, received from America a bottle of rum displaying on its label a negro's head and chest. By coincidence, about that same time a Chicago packer sent to Africa a consignment of corned beef, using the picture of a native as a trademark; dozens of these tins appeared in the only store in the Ababua country.

People, meanwhile,





The jungle yachts line up before a village of Mangbetus, whose fathers besieged Stanley's followers

were continuing to disappear mysteriously. In their stead appeared that bottle, which the planter's boy announced was filled with native blood; and those tins, evidently containing flesh of vanished tribesmen.

This idea was too dramatic not to fascinate the crude mentalities of the Ababuas. The story spread like fire, labor deserted the plantation, the trader had to close the store and run for his life, the Administrator got a super-headache.

At the climax of this inflammable situation, we approach, preceded by terrifying messages bouncing from one tom-tom to the next. "Here they come," the drums say, "the headmen of the Bwanas who kill natives, and put their blood and flesh in bottle and tin." Our big trailers, with their electric plants going even when the wheels remain motionless, evidently are heralded as factories in which we carry on our macabre industry.

And here Dominick en-

Twenty-foot crocodiles lie on the river bank hoping your bridge of vines will fall



Tumbako, our pygmy friend, earned his name from the way he called for tobacco





Natives who might have attacked us 50 years ago now entertain us
Pygmies wove us a vine bridge high over crocodile-infested river



You meet terrifying beasts in Africa, but don't be alarmed if you
run into that horned monster below, for he's only a chameleon
The captive okapi traveled to camp under his own power in bot-
tomless cage at right. Pygmies cleared a path through the jungle



ters. He is imagined to be a poor devil of a native, stuffed for use as an emblem of our horrible trade.

After such a build-up, naturally it takes some time to persuade the Ababuas to come back and lose fear of us. But no time at all to give Dominick a well-aimed kick that dissolves him into his elements of straw, wood and sacking.

The Wagenias last month, the Ababuas today, have given you the first taste of a world of customs, of mentalities, barely touched by civilization. But now we will abandon the luxuries of our big camp and this lone road crossing the 200,000 square miles of equatorial jungle, and plunge into another world which has remained unchanged for thousands of years.

Put on a good pair of boots, so that no cobra or mamba can strike at your legs. No, don't wear shorts, unless you want poisonous thorns, insects and nettles to inflame your knees. Trousers of heavy khaki drill are the thing. Fasten securely your helmet strap. At

21429

2197

every step, branches will try to tear it off your head and around one of them a naja might be coiled ready to strike you in the neck, and that means instantaneous death.

Is the snake-bite kit fastened to your belt? Is your rifle loaded and on the safety? Vines will try continuously to snatch it from your hand. Some might catch the trigger and I wouldn't be amused to receive an accidental bullet in my back. Why not keep it unloaded, or let a native carry it? What would you do, then, if a leopard falls on you from a tree; if a pygmy buffalo attacks you, or a herd of mzei, the smallest and most vicious elephants, suddenly charges? No, keep your rifle with you every minute. Try to put your feet on the very marks of mine, not to fall into a spot of quicksand or stumble onto a caravan of millions of biting ants.

The boys will follow us; with our tents, beds and supplies on their heads, they know their only defense is to stick near us and our rifles. Mrs. Gatti will close the march with the cameraman.

All ready?

"Ngufu, boys! Funga safari!!"

Of course I wouldn't dare to get into this jungle for a moment without Mambuti pygmies for guides. We would be lost immediately. I know well this old elephant path, but beyond their village I wouldn't venture without them.

See those trees? Mahogany, ebony, cottonwood, ironwood, rubber, wild cocoa. Some of them are 200 feet high, sixty around the base; many are still unnamed by science. In one expedition I gathered 36 kinds of moss that a botanist is now classifying. No white man has ever been in this unending expanse of semi-light and deep darkness long enough to discover even the thousandth part of the secrets it contains. Only its borders have been mapped. There are rivers, mountains, swamps, mammals, snakes, insects, birds of which nothing whatever is known.

Psst! Stop!

O.K. They have gone. What a racket they made, running away. Two giant forest hogs, five feet high, seven from snout to tail. Prehistoric animals, too. Bones similar to theirs can be found fossilized, millions of years old.

But wait until you see the okapi, the best "living" fossil of all. Discovered only forty years ago, not until 1919 was a live speci-

(Continued to page 178)

JULY, 1941

Self-Feeding Small-Part Bin Is Loaded Through Top



Bottom bin replenished by filling chute at back of case. Diagram shows arrangement of chutes and bins

Individual compartments of a bin for storing separate supplies of nuts, screws, washers and nails are so arranged that they can be filled through the top. There are 12 compartments, each having an opening at the front of the bin where workers may readily help themselves to any of the parts, the latter feeding downward by gravity as they are used. The bin measures 9 by 16 inches.

Room Humidifier Is Kept Filled By Automatic Valve

Connected to the air vent of a hot-water radiator, an automatic room humidifier keeps itself filled without further attention. It is a copper evaporating pan, built flexibly so that it will fit between the coils of any radiator. As the water in the pan rises to the level of the valve, the flow is automatically shut off. Evaporation lowers the water level and the valve opens. This system also keeps the radiator free of air. No tools are required to install the humidifier.



Weeks Valve Co.
3308-14th St. N.W.
Washington D.C.

*Metal Products, Inc.
Cucurora, N.J.*

L 1 Cont. Allen - Warren Aircraft
343 & 33rd, New York City.



Large stationary machine starting cuts in locomotive side frame

Courtesy Linde Air Products

CARRYING *the* TORCH



BORN during the excitement of the first world war were two of the most important industrial twins that ever joined the huge family of mechanical devices and methods which constitutes America's mass production system.

These twins, welding and flame cutting, have grown so steadily and quietly during the generation between conflicts that not until the United States started to prepare for defense in recent months did the nation begin to realize how much the husky pair have changed the industrial picture.

In the factories, arsenals, shipyards and steel plants of the country today they are literally carrying the torch for industry, lighting the way toward the goal of preparedness.

Strangely enough, the art of electric resistance welding was discovered and demonstrated early in the year 1886

Left, closeup of welder in protective helmet. Welded construction provides greater mechanical strength, more compact designs and lighter weights



Circle, oxy-acetylene process called gouging removes narrow strip of metal from steel plate. Right, portable flame-cutting apparatus in use



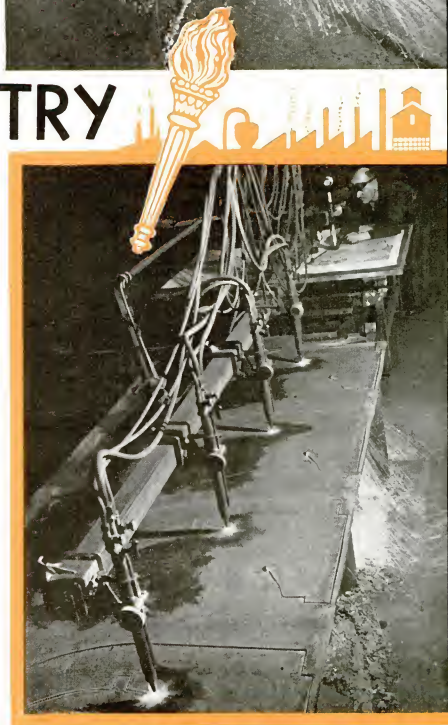
for INDUSTRY

but for some reason no one did much more than talk about its possibilities for nearly thirty years. At the beginning of the first world war, welders were so scarce that, garbed in their unearthly hoods, they looked as queer as men from Mars and were as seldom seen by most of the public.

Then came that war and the industrial speed-up. Frantic executives delegated with the duty of producing cargo ships in months instead of years hesitantly tried welding in the place of riveting in some spots. Munitions producers and other war-material manufacturers gave the few expert welders then trained a chance to prove their art would save time and money. Flame cutting was employed more widely. Just about the time the torch was on the way toward popularity in the factories of the nation, the war ended and welding became better known for its failures than for its successes.

One weakness was the tendency of the metal when fused to absorb enough oxygen and nitrogen from the atmosphere to lower its strength. Another

Right, multiple flame-cutting operation which makes possible absolute uniformity of size, accurate spacing of openings, clean-cut edges and exact duplication of parts



Built by Chicago Bridge & Iron Co. 249 S. Old Chicago Rd. for Carbonyl Co. Bldg. Electric. Chicago

Welding house



Above, welding sections for large waterwheel generator

drawback was the scarcity of expert welders. The welding tool, whether of the arc or resistance type operated by electricity through electrodes, or the blowpipe type, using oxygen, other gases and a flame, became mostly a handy adjunct

Right, workman welding giant turbo-generator frame in Westinghouse plant



Above, sphere for storing hydrogen gas, fuel used in tool making

of small shops and was used mainly for minor repairs, like those on automobile parts.

Shipbuilders continued to weld on repair jobs. The railroads also patched boilers and tubes and fixed broken metal parts. Steam engine and machinery plants used welding, but this was also to mend, not to manufacture. In England, an entire barge was successfully welded for channel service; still the lesson was overlooked.

But scientists and industrial engineers had not forgotten the wartime work. Through constant research, the quality of arc welding was stepped up by putting a flux coating on electrodes to offset the effect of gases of the atmosphere, and improving temperature controls.

Left, steel flooring being fabricated with arc welders
Courtesy General Electric Co.

The efficiency of oxygen welding and cutting was gradually increased by raising the purity of this gas from 97 percent to 99.5 percent, a vital improvement.

Large electrical companies, like General Electric and Westinghouse began to weld machinery parts. Here and there welding replaced riveting on industrial building frames. Central refrigeration system manufacturers were early to try welding. A tank manufacturer induced a buyer in the oil fields to try a great storage tank without rivets. A steel press was produced costing little more than one-third of the estimate including a cast frame. A Chicago manufacturer began to weld gear blanks rather than cast them. Steel corporations started to weld some products rather than cast or forge, Bethlehem Steel welding some huge ladles with a 190-ton capacity.

Welded tugs began to appear on the lakes and

(Continued to page 166)

*Women's Hospital
Pittsburgh, Pa.*



Above, masked welder joining two beams in building in which 2,300 pounds of welding rods replaced 30,000 pounds of rivets

Below, building up worn ends of railroad rails by the welding process



Below, air mechanics students at work in mass-welding class. Three hundred army men are to take course in this New York school

Ex weld Railroad Service Co



Snowflake Crystals Preserved in Plastic Film



Top, Vincent J. Schaefer with his snowflake casting equipment; microscope is used only to pick out the flakes he likes. Bottom, left, making casts on a glass slide; right, enlarged photos of casts

Permanent castings of snowflake crystals are being made by coating the flakes with a thin, transparent plastic film. As worked out by Vincent J. Schaefer of General Electric Research Laboratory, the only essentials for the job, besides a snow flurry, are a board or light table covered with black velvet to catch snowflakes, a toothpick for picking them up, some glass mi-

croscope slides and a solution of the plastic known by the trade name of Formvar 15-95. This equipment is used outdoors so its temperature will be the same as the surrounding air when the snow falls. A snowflake selected as suitable is laid in a drop of the plastic solution on the glass slide, and another drop placed on top of the flake. Soon the solvent evaporates

leaving the flake incased within a shell of resin, which may be taken indoors, for study or photographing through a microscope. The solution solidifies into a mold with a thickness about 8/100,000 inch. By modifying the method, permanent records can also be made of such perishable formations as hoar-frost and frost crystals.

Paint Mixed in Can By Self-Timing Conditioner

Paint that has been standing on the store shelf may be mixed thoroughly before it is delivered to a customer by placing the unopened can in a paint conditioner equipped with a self-timer. The machine will automatically stop operating at the end of any predetermined period of time up to fifteen minutes, according to its setting. Four one-quart cans of paint can be mixed at the same time.



Conditioner for mixing paint in the can may be set to run for any length of time up to fifteen minutes

Jap Fire Fighters Carry Bombs To Put Out Air-Raid Fires



Wearing special heat-resistant suits, these "minute men" of Japan use the bombs strapped around their waists to put out fires started by air raids

Well protected by heat-resisting suits, Japanese firemen, whose job it is to answer air-raid calls, also have fire-extinguishing bombs strapped to their waists. The bombs literally blow out flames, being particularly useful in cases where the fire has not gained too much headway.

Postcard Duplicating Machine Operated by Hand

Housed in a one-piece plastic case molded of Textolite, a simplified postcard duplicator, operated by hand, produces copies at a speed of 1,000 cards per hour, resulting in low operating cost. Stencils are inexpensive and require only a few minutes of typewriting or work with the stylus furnished with each machine.

A gravity feed makes insertion of cards easy and insures evenness in printing and registration. Printing pressure is equalized by a full-floating assembly, resulting in uniform copies in large and small runs.



JULY, 1941

London, P. Smith
elms, Harrington, N.J.

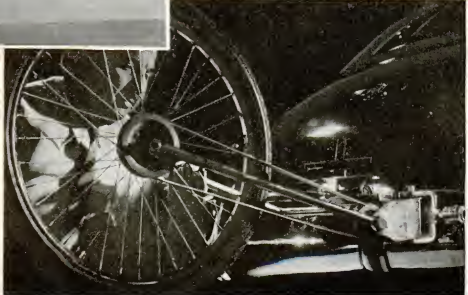
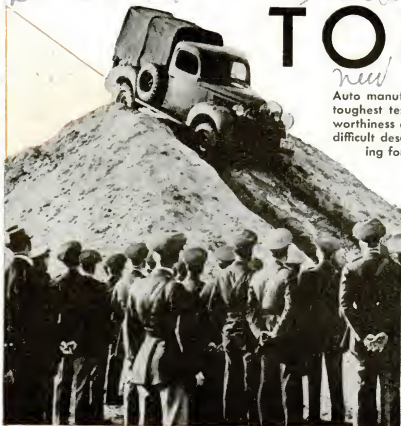
Pac Mfg Co.
641 Ohio, Tenn.

77

Hamite
clad

TORTURE

Auto manufacturers subject stock cars and trucks to the toughest tests they can devise in order to establish the worthiness of new designs. Left, army truck negotiating difficult descent at Dodge plant. Below, test car "reaching for the stars" in night run on steep grades



Above, car "waltzing" over "wobble road" at Ford test track. The section consists of double line of staggered concrete mounds over which cars weave, twist and leap at 30 miles per hour. Right, examining "fifth wheel" that records speed. The wheel is attached to a car undergoing tests at the General Motors proving ground

Photo courtesy Cadillac Division

Lodge Club Ray Ray June 26 4
Electric

BY THE MILE



Circle, here's what happens when test car speeds through water pit to check resistance of parts to moisture. Above, control panel at which operator can create a blizzard to test Mercury in tunnel

Right, panoramic view of Ford test track showing three separate sections. This is one of the most complete "torture" layouts in the industry. When test drivers complete their work the cars are torn down and studied, part by part, to insure the ultimate in performance in models approved for production. Ford alone conducts runs approximating 5,000,000 miles each year. Below, what happened when a Plymouth test driver sped through a cornfield at 40 miles per hour. This sort of punishment tests oxles and frames. Among other tests are those on Belgian block roads where boulders projecting as much as six inches above a concrete bed pound and jerk a car unmercifully, and a mud pit in which clay and water six inches deep form a quagmire through which cars skid and slide



Paddles for Truck Wheels Pull Through Mud



Rim equipped with paddles fits outside truck wheel

Attached to the outside of each rear wheel, an auxiliary wheel for trucks is equipped with protruding fins to assure traction when traveling over muddy roads. On the pavement, the paddles clear the road by three inches.

Paint Brush Holder and Wiper Keep Can Clean

Paint cans used in the home usually become soiled from paint running down the outside, the result of wiping the brush on



Left, wiping bar; right, brush holder and handle

the upper edge of the can and placing it across the top at intervals. This inconvenience can be overcome by using a strip of metal that serves both as a brush holder and handle for the can. Available for half-pint, pint and quart cans, it is shaped to clip onto the top and bottom edges, having an extension above the can on which the brush may be suspended so all the drippings fall inside the paint can. A loop outside the can forms a carrying handle. The wiping bar consists of a separate piece of heavy wire bent so it will stay in place when wedged against the top edge. This provides a straight instead of a curved edge for wiping the brush.

Cause of Motor Vibration Found With Lightweight Meter



Frequency of vibration is indicated by meter scale

Troublesome vibrations in machinery can be located with the aid of a vibration frequency meter weighing only half a pound and operated by hand. It automatically indicates frequencies between 500 and 20,000 a minute. Manipulating a knurled knob helps to determine the frequency of vibration which is read directly from a calibrated scale on the frame of the instrument.

Names and addresses listed in the index, page 4-A, show where to buy manufactured products described in this magazine. Say you saw it in Popular Mechanics.

Double-Deck Stretcher Fits in Delivery Truck

Shortage of ambulances inspired the invention of a double-deck stretcher carrier that holds four persons. It is a lightweight iron frame designed to fit into a delivery truck in less than a minute, thus converting it into an ambulance. Test patients stated that riding in this fashion is as comfortable as a ride in an ambulance. Invented by Mabel Board-



Lightweight metal frame designed to carry four stretchers, above, can be placed in a delivery truck, as shown at left, converting it into an ambulance when emergency may demand.

Washington, D.C. man, secretary of the American Red Cross, the frame handles standard stretchers. Besides the Red Cross, military and government health agencies are planning to acquire large quantities of the frames for use in hospitalization work. It will save the necessity of keeping hundreds of expensive ambulances in readiness for emergencies. Instead, trucks may be borrowed from commercial organizations and the stretcher frames placed inside quickly to receive patients.

Disk File for Flat Surface Smooths Automobile Fenders

Used with a scouring motion when working on rough surfaces, a disk file grinds to a smoothness not possible with sanders or other files. It has particular advantage in rubbing fenders to a smooth finish after large dents have been pounded out. A strong center handle gives a good grip for operating the tool which is made in several styles, including rasp surfaces.

Motorists burned 22,079,789,000 gallons of fuel in the United States during 1940, an increase of 6.5 percent over the amount they used the previous year.



Disk file with upright handle smooths large surface

JULY, 1941

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Dry-Land 'Boat' Helps Soldiers Learn Landing Tactics



While one crew rocks this dry-land "boat" other soldiers climb down the side to get the "feel" of making a landing from a troop transport ship

Lack of a transport ship and ocean beach does not deter men of the 53rd Infantry at Camp Ord, Calif., from going in for landing party exercises. Scaffolding with a net draped over one side, which the men call "black beauty," is made to simulate high-sea conditions by rocking and pitching it with ropes and pulleys. On the order to "go over the side," soldiers scramble down the net and into a small boat underneath as though they were actually in the act of making a landing.

American Heads Grow Broader As We Do Less Chewing

Americans are developing broader heads. This is found to be particularly true of the intellectual classes, Dr. Ales Hrdlicka, curator of physical anthropology of the Smithsonian Institution, reports after a study of large groups of three-generation Americans and of a group of America's foremost intellectuals. One factor, he says, is the increasing use of softer and more concentrated foods requiring less chewing, especially in childhood. For lack of exercise the chewing muscles along the sides of the skull are less developed, and with less pressure from these muscles the skull en-

larges more sideways as it grows. The larger head of the intellectual person is due in part to continuing increase in size of the brain inside the skull, even late in life. As the growing brain must make a place for itself the skull gets thinner and larger.

'Bike' Bar Detaches To Convert It for Man or Girl

Four simple parts which can be attached to the frame of any standard bicycle make it possible to convert the "bike" from man's style to woman's, or vice versa, in two minutes. The invention, patented recently, consists of changeable bars that connect the steering post with either of two points on the saddle post. There is no loss of strength nor sacrifice in appearance.

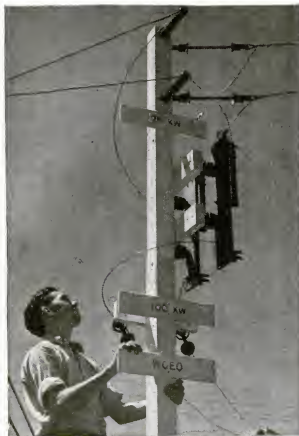


The man's bicycle, top, is converted for woman's use, below, by changing position of the detachable bar

*275. Allen Warren Elliott
3438 33.4*

The BATTLE of BEAMS

Ward & City



Left, power change switch at General Electric short-wave transmitters, South Schenectady, N. Y. Right, the 100-kilowatt transmitting tube of WGEO, western hemisphere's most powerful short-wave station, is cooled by a constant stream of water pumped through it. The delicate filaments are replaceable

THERE'S a world-wide war of ideals being waged in the air, and Uncle Sam's in the thick of it.

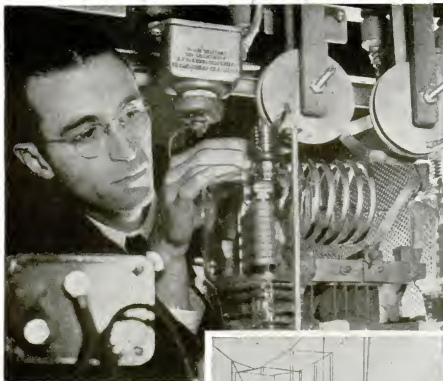
The battle of beams is fought around the clock. The nation's great short-wave broadcasting stations fling out broadsides of truth to explode over Europe, Latin America and the Far East, and blast away at propaganda unfavorable to American customs, beliefs, products and policies.

It's a conflict that started years before Nazi troops marched into Poland. It will certainly continue through the current war and probably through the post-war contest for trade, regardless of the outcome of hostilities.

One of the most spirited "armament" races in the world is going on in the laboratories and factories where radio transmission in-



Dr. Peter Wold and students of Union College physics department broadcast audible breaking down of atoms into electrons

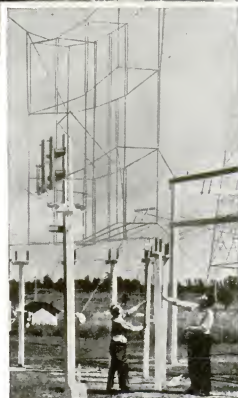


Top, a G. E. engineer inspects WGEO transmitting equipment

Right, antennas and beam changing equipment of Schenectady "propaganda" stations

struments are conceived and manufactured. Determined to meet word with word, kilowatt with kilowatt, Uncle Sam has told this nation's short-wave stations, many of which were too weak to reach foreign countries effectively, to step up their power or step out of the picture. A few stepped out, but ten stations are spending more than \$2,000,000 to bring their transmitters up to the 50-kilowatt minimum power standard ordered by the Federal Communications Commission. Two others already qualify.

Though American engineers were the first to discover the advantage of short waves for transmission over great distances, few Americans took notice of the shafts aimed at this country during the pre-war years from suddenly powerful European



stations. These propaganda broadcasts told South America the United States was imperialistic; told Asia that America had designs on China.

It was not until 1939 that Uncle Sam had a voice equal to the overseas transmitters. Early in that year, General Electric, which since 1923 has operated short-wave stations at Schenectady, N. Y., equipped WGEO for 100-kilowatt operation, making it the most powerful short-wave station in the hemisphere.

Two 100-kilowatt tubes with demountable filaments, the first ever made, were built for the station. At the same time special double panel antennas, designed by Dr. Ernest F. W. Alexanderson, which increase signal strength 10 to 20 times in a given direction, went into service on WGEO and a sister station, WGEA, in Schenectady, directed on London, Rio de Janeiro and Buenos

Below, testing characteristics of vacuum tubes in laboratory

Aires. General Electric also added a third short-wave station, KGEL, at San Francisco, beamed alternately on Latin America and the Orient. Other American short-wavers began to improve stations and programs.

Meanwhile, in the bitterness of war, anti-American radio tactics became even more disagreeable and Europe began to broadcast propaganda all over the dial.

Finally Uncle Sam got mad. Surveying his armaments in this war of words, he found only WGEO and the Crosley Corporation's WLWO in Mason, O., now increasing from 50 to 75 kilowatts, with power enough to cut through the tropical static to South America under all conditions. A few months ago came the order to speak up to at least 50 kilowatts, or to shut up. Those speaking up are: World Wide's WRUL and WRUW, Boston; Columbia's WCBX, on an island in Long Island Sound, and WCAB, Philadelphia; National Broadcasting Company's WNBI and WRCA at Bound Brook, N. J.; Westinghouse's WBOS and WPIT, and General Electric's WGEA and KGEL.

No governmental control over programs has been established despite the diplomatic nature of the foreign contacts. The short-wave stations will not meet dirt with mud, but present news and facts, a policy which is certain to stand out in the scrambled

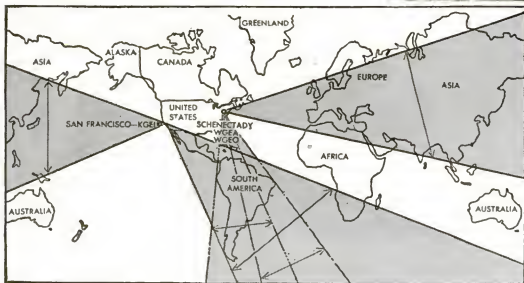
(Continued to page 185)



Before the precise hand-finishing, quartz crystals for use in maintaining short-wave transmitters at proper frequency are reduced in thickness by machine lapping. Time switches control the operation



Mrs. Carl Eklund of Ossining, N. Y., talking over the WGEA microphone to her husband, then with the U. S. Antarctic Expedition in Little America



The map shows how G. E. short-wave stations at San Francisco and Schenectady are beamed to fan out over the Orient, Europe and Latin America

2260 Laurel Lidster 5625 Wilshire Blvd
Movie Camera Fans Rent Idle Stage Settings
 Los Angeles



Members of motion picture camera clubs who do not own scenery and "props" for filming screen plays are turning to the Little Theater groups in their localities that often are willing to allow them to use stage, backgrounds, furnishings and lights for a small fee while the players are not rehearsing. Over a long period of time a Little Theater group accumulates varied sets that represent the past, modern and futuristic in both interiors and exteriors, and usually there are plenty of decorations as well as a wardrobe of costumes to match any of the periods. One group that offers its facilities to amateur movie fans is the Players Work Shop, of Los Angeles, Calif.

2343
**Nicknames for Car Parts
 Used at Assembly Line**

Workers at automobile assembly lines, shunning conventional names for the parts they handle, have evolved a jargon of their own. For instance, the uninitiated might wonder at hearing an assembler ask to have a "blue goose" bring him a "bunch of bananas" and to take along a "fish pole" for the "chatterbox." Of course, the blue goose is a man who makes special deliveries of assembly materials when regular stocks run low, and he will know that a banana is a bumper guard, while chatterbox and fish pole designate a car radio and aerial. Here are other spicy examples: Rearview mirror is called a cheater; sun visors, blinders; floor carpet, the rag; rear end body section, balloon assembly; overdrive, booster; metal ring around push-button door controls, horse collar; direction indicator, flash or firefly; battery, juice box; carburetor, pot; exhaust, snort pipe; crankshaft, wrinkle rod; tire, hoop; inner tube, wind bag; and a car with right-hand drive is a foreigner.



Two members of motion picture club, top, filming a scene for screen play on Little Theater stage. Center, rehearsing actress in period pictures. Bottom, picking out backgrounds which are still in storage from past productions

2302

Compact Two-Way Radio Built for Lightplane

Combining advantages of compactness, light weight, simplicity of operation and reasonably low price, a two-way radio now available answers the need of the lightplane owner for a communication system. Complete with batteries, headphones, microphone and shock-absorbing mountings, the equipment weighs 10½ pounds, being housed in two cases each 4½ inches wide, 3¾ inches high and 7¾ inches deep. One case contains the receiver-transmitter, and the other the batteries which have a useful life of more than 100



Two small handfuls—one case containing a two-way radio unit and another the batteries, etc.—weigh only 10½ pounds, making compact radio communication system for lightplane

Receiver-transmitter may be mounted on plane floor near pilot. Volume control and tuning knob operate the receiver, while a press-to-talk button is the only control required for transmitter

hours. The transmitter, of 2½ watts, is capable of broadcasting 35 to 50 miles, and the receiver has a range of 150 to 200 miles for radio beacon signals, airport and weather information. There are only two receiver controls, the tuning knob and volume control, while the microphone has but

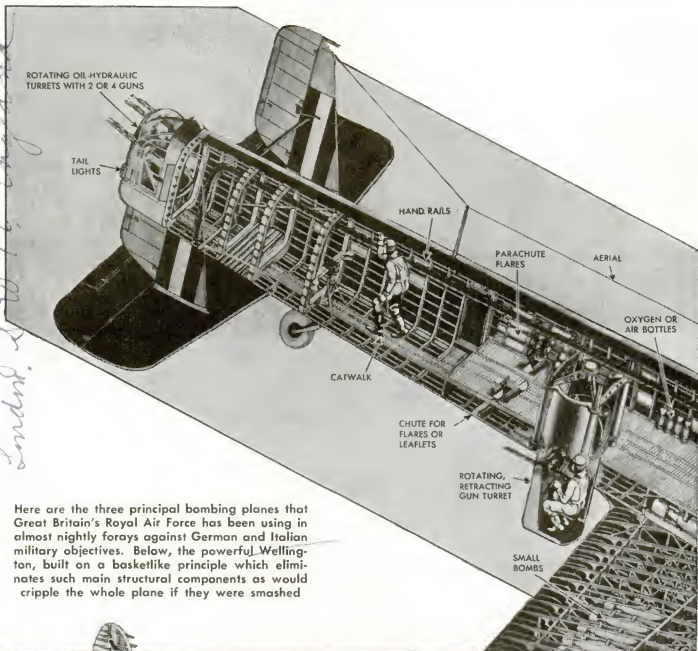
one control, a pushbutton. For the pilot who wants only a receiver, the radio and batteries are housed in a single case weighing little more than five pounds.

Over two billion nickels have been minted since Congress authorized the coin in 1866.

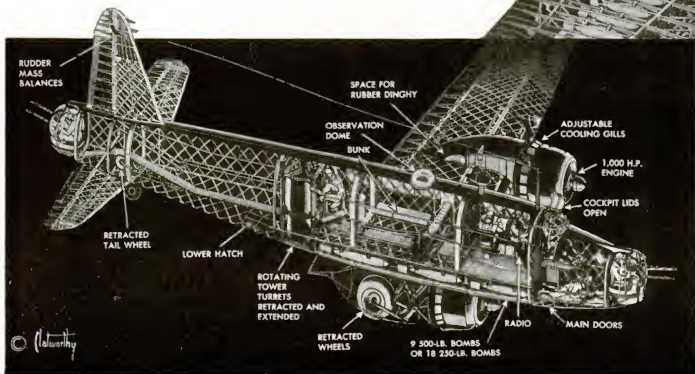
101 Associated Press, Inc. 1/1/41

Three Big Bombers Used By Royal Air Force

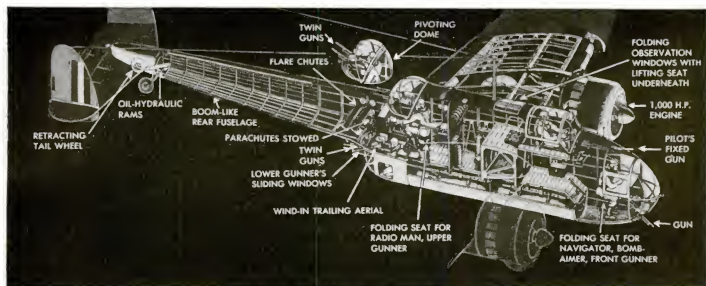
S. W. Clatworthy, 8, 4, Lewis Road, London, S.W. 16, England



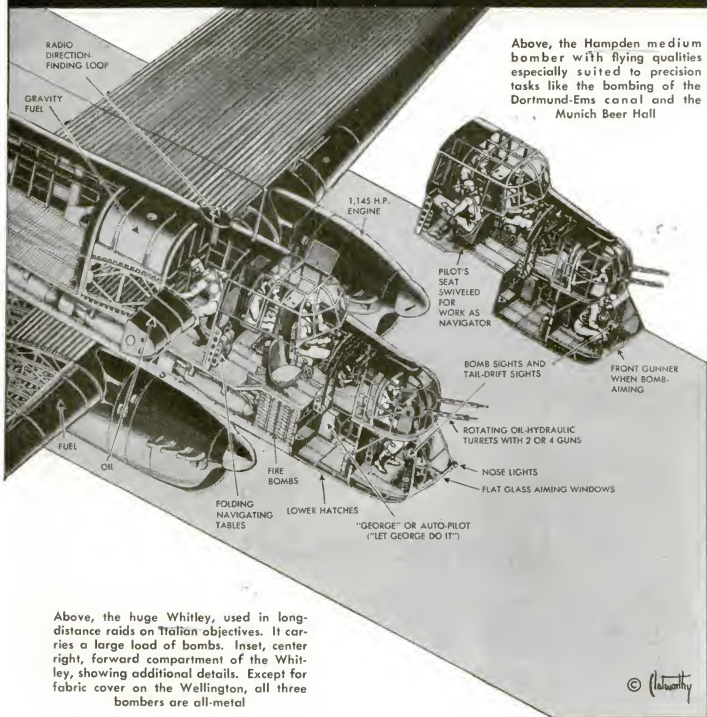
Here are the three principal bombing planes that Great Britain's Royal Air Force has been using in almost nightly forays against German and Italian military objectives. Below, the powerful Wellington, built on a basketlike principle which eliminates such main structural components as would cripple the whole plane if they were smashed



Planes for Long-Distance and Precision Raids



Above, the Hampden medium bomber with flying qualities especially suited to precision tasks like the bombing of the Dortmund-Ems canal and the Munich Beer Hall



Above, the huge Whitley, used in long-distance raids on Italian objectives. It carries a large load of bombs. Inset, center right, forward compartment of the Whitley, showing additional details. Except for fabric cover on the Wellington, all three bombers are all-metal

349.

Outboard Motors Ferry a Tank on Pontoons

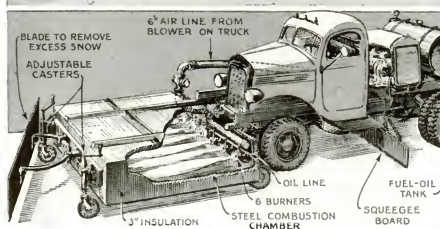


In maneuvers on Fort Knox reservation, army engineers ferry a tank on pontoons. Notice outboard motor, left

Four outboard motors attached to pontoons gave the army oarsmen a boost in ferrying a tank across the Salt River on the Fort Knox reservation recently. The

equipment used in the maneuver was constructed by the army engineers from parts of a regular pontoon bridge and a section of a portable steel truss bridge.

Flame-Throwing Snowplow Melts Ice Missed by Blade



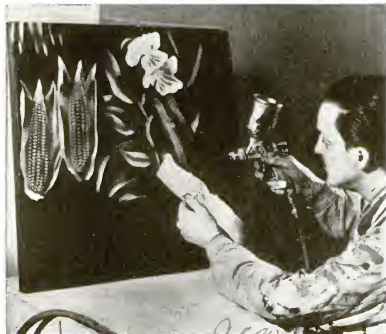
Snow removal truck has broad heating chamber mounted in front to melt snow, and squeegee underneath. Top, cleaning snow from airport runway

Snow and ice missed by the plow are melted and water remaining on the pavement is removed by a machine invented by John B. Sweeney, of the Allegheny County, Pa., Bureau of Maintenance. The apparatus, which is pushed by a truck, was designed especially for use on the runways of the County Airport at Pittsburgh, Pa. Even in the severest snow storms it is able to keep clean a runway 150 feet wide. A movable blade in front of the unit sweeps aside excess snow. Behind the blade is a snow melter, consisting of a boxlike combustion chamber open at the bottom, into

which six oil burners shoot flames creating a temperature of 2,000 degrees Fahrenheit. Water left on the runway by the heater is squeegeed off by a board beneath the truck. On the truck is a 350-gallon fuel tank and a six-inch blower that supplies pressure to atomize the oil. The unit travels 6 to 15 miles an hour, depending on the depth of snow. On highways it is believed capable of clearing two lanes at a cost of about two dollars per mile. Where excess water may be encountered, a centrifugal pump and small tank can be installed on the truck to suck up the water from the road and throw it 75 feet to either side. In that case, additional squeegee boards at the sides would aid in collecting water under the pump.

Painting Enameled on Steel By Mural Artist

Although the art of enameling on metals has been traced back to ancient times, a Cleveland artist, H. Edward Winter, is acclaimed as the first in this country to do a mural painting in enamel on steel. Using modern technical equipment to improve on the ancient art, Mr. Winter is engaged in preparing a mural panel for the post office at Cassville, Mo.



The artist enameling a mural painting on steel with a spray gun

Ultrahigh-Speed X-Ray Picture "Freezes" Electric Shaver



This X-ray of a man shaving was taken at 1/1,000,000 second

Through the magic of X-rays, engineers are able to peer into the interiors of machines and take pictures at a speed of 1/1,000,000 second to study what happens within while the machine is running. One photograph of a man shaving "stopped" the electric shaver as it ran full blast, its tiny motor making more than 116 revolutions per second. Similar pictures may be made of larger motors, even through their heavy metal coverings. High-speed X-ray photography, developed by Dr. C. M. Slack, of Westinghouse Research Lamp Laboratories, Bloomfield, N. J., uses a tube producing X-rays instead of visible light as for ordinary flash photos. Condensers, charged to about 90,000 volts, release the current suddenly, resulting in a jolt that takes place in about one microsecond, or 1/1,000,000 of a second. Such speed, however, is required only where the parts to be photographed move at high velocity.



JUST



Don't hold your arms rigid if you fall backward (left); you may break them. It's safer to bend them (right) to absorb the shock and try to sit down and roll back onto the shoulders

SOMEONE you know is going to tumble downstairs or fall off a ladder before the year is over and be seriously hurt. There is even a good chance that it will be yourself.

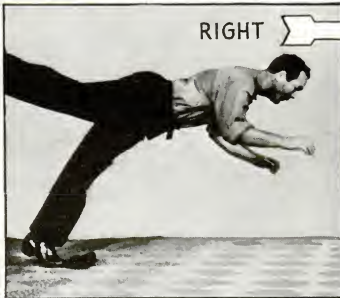
Nearly five million people in the United States will be hurt in accidents in their homes this year and about 32,000 of them will die. Yet in the same length of time a small group of Hollywood stunt men will deliberately flirt with death thousands of times and the chances are that not one of them will even break an arm.

True, when a stunt man has a bad fall he does it on purpose while your accident

is certainly unexpected. Even so, there are a few tricks the stunt man knows that may save you some broken bones the next time you trip. The first thing a stunt man learns is the truth of the old saying: "It isn't the fall that hurts you, it's the sudden stop."

Remember that, the next time you dash around a corner and bump into another pedestrian. Your feet slide out from under and down you go, possibly breaking an arm or a knee cap. Put a stunt man in the same place and he instinctively protects himself. He'll try to fall against the wall because that will slow him up. If he's off balance and can't reach the wall he twists

If you fall as Harvey Perry does at left, you're apt to hurt the stiff arm and hand. At right he begins an easy fall, bending the arms so they won't hit the ground rigid and starting a twist



RELAX



The harmless backward fall begun on opposite page finishes on the shoulders, which take most of the jar

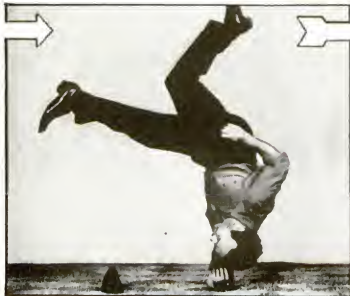
to one side, bends his knees and tries to sit down or double up before he lands.

Falling, a stunt man makes the same instinctive gesture of throwing out an arm to break his fall that you do, but one important difference. The average person absorbs the whole shock of the fall on his tensed wrist. Maybe he snaps or dislocates a bone, just be-

Below, finish of a safe forward fall. Alighting on left forearm (left) Perry rolls on over and falls flat



Prevention is less painful than cure, so don't leave things where they'll trip you





Lilyan Porter, 20th Century-Fox actress, demonstrates how not to hang a calendar

Tripping downstairs, Miss Porter shows how to slump against wall and grab banister



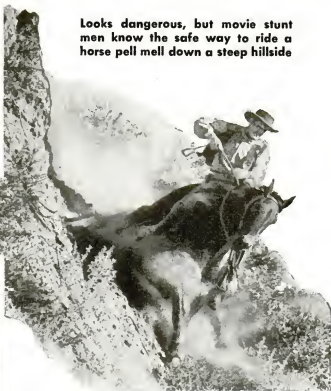
cause he tries to stop all at once instead of a little at a time.

The stunt man relaxes and takes only a little of the jar on his hand, a little more on his bent arm, and the rest of the fall on his shoulder. Instead of trying to stop as he hits the ground he rolls so that no one part of his body will take the whole shock.

That's one of the secrets of how such a man as Harvey Perry stays alive. Before next Christmas Perry will drive half a dozen cars into brick walls, be tossed off a few cliffs, fall down innumerable flights of stairs, and dive off a roof or two. Falling off horses and wrecking cars are the stunt man's daily diet, yet not a man has been killed at it in 10 years and only three have gone to the hospital. Perry is a better insurance risk than many people, for one thing because he tries to be a safety engineer first and a daredevil last.

When he is paid \$75 for skidding a car and from \$35 to \$300 for a fall, on top of a good salary, he isn't paid just for his nerve

Looks dangerous, but movie stunt men know the safe way to ride a horse pell mell down a steep hillside



but because he can do exactly what the director wants and then get up unhurt and repeat the stunt if needed. Perry can't afford to get hurt. He's one of the most careful men you ever met. He uses a rubber mat in his shower. He keeps his car doors locked while driving. He's afraid to balance an apple box on a chair and climb up on it to tack a picture to the wall.

Bathtubs and stairs are two particularly lethal instruments and account for far

28

more deaths than do hunting accidents. More accidents occur on the stairs than in any other part of the house, yet to Perry a fall downstairs is one of the safest he knows. Whether you slip in the tub or fall off a ladder the thing to do, Perry tells you, is to try to fall against something on the way down. If you can't, go limp instead of resisting the fall, and try to roll as you hit. But if you are really smart you will eliminate common hazards from the home. Keep the floors clean of grease and other slippery substances, use nonskid pads under the rugs, keep stairs free of toys and other articles over which you might stumble. Get out of the bathtub sideways while holding on to something instead of standing up and stepping over the rim. A handhold on the wall may save you a big doctor bill. In fact the cheapest insurance is a dollar or two spent at the dime store for safety gadgets and anti-skid pads.

Use a short stepladder with nonskid pads under its legs for reaching up into a high cupboard instead of piling boxes on a chair. If you should ever fall with a ladder, try to stay with it and roll off as you hit the ground. The only time it is smart to leave a ladder in the air is when it is headed for a glass window.

You may never have to jump from a burning building into a fire net but if you ever do, now is a good time to learn how. Don't try to land standing up; you may break a leg. If you land in a sitting position your knee may fly back and break your jaw. The safest way to land is on your back with your feet high. It was such instructions as these that Perry gave William Tracy before the star put on a rough and tumble performance in "Tobacco Road."

Perry's bones are just as brittle as yours and no stunt man can fall off a roof without hurting himself unless he prepares for it. Before Perry does a high fall for the camera he dresses up in protective pads like a football player and he lands on a thick sponge-rubber mattress buried in the ground and concealed by a "ground cloth" over which dirt has been sprinkled. But if the pad wasn't there Perry would still be able to minimize the effects of a high fall. Touching feet first, he would double up immediately and roll along the ground. "It's the same rule of the sudden stop that hurts," Perry says. "Watch an acrobat falling into a net or how the man

(Continued to page 164)

JULY, 1941

C.A. Higgins, Pres Powder-Plant Escape Chute Provides Speedy Exit



A quick slide down chute lands you outside building

Should danger of fire or explosion threaten at the new \$44,100,000 plant of Hercules Powder Co., at Radford, Pa., workmen will have a quick means of escape. This consists of metal emergency exit chutes through which the men can slide to safety.

Flower Bowl Built in Lamp Base

Freshly cut flowers floating at the base of a modernistic table lamp receive a soft glow from the metal shade of double-mushroom design, creating a striking decorative effect. The bowl holds sufficient water to keep the flowers fresh.



Replenishing water in flower bowl at base of lamp

Metallic Arts 1523 S. Michigan Chicago

Rail Freight Rides New Streamline Lake Ferry



Left, the "City of Midland" crosses Lake Michigan on her maiden voyage. Below, a string of refrigerator cars rolls onto one of the ferry's four tracks. The ship carries 34 loaded freight cars



3 30
Motoring tourists and railway freight trains alike can take a short-cut across Lake Michigan between Wisconsin and Michigan aboard a new \$2,000,000 ferry, the "City of Midland," a streamline addition to the Pere Marquette railroad's ferry fleet. Plying between Milwaukee and Manitowoc, Wis., and Ludington, Mich., the all-steel 8,200-ton ferry can accommodate 50 passenger automobiles and 34 loaded freight cars on her four-track car deck. There are 74 staterooms, a lounge and dining salon. The cabin deck accommodates

376 passengers. Backed up to the shore tracks, the ship's stern apron is raised and freight cars are rolled aboard, jacked and securely fastened for the trip.

Student "Flies Beam" on Ground to Speed Up Training

3 32
An inexpensive method of training for student pilots learning radio orientation as associated with "blind" flying has been made available through development of a compact

radio-signal instrument designed for ground instruction. Approved by American and British air force officers, airline pilots, instructors and students, the Orientator aids the student in acquainting himself with the numerous signal blends found in "flying the beam," thus reducing by about 75 percent the four to eight hours of flight training usually required.



Orientator reproduces signals used in "blind" flying for teaching pilots

American Aircraft Radio
2201 S. 1st Ave. Aero Industries
2226 N. Howard Ave. Los Angeles, Calif.



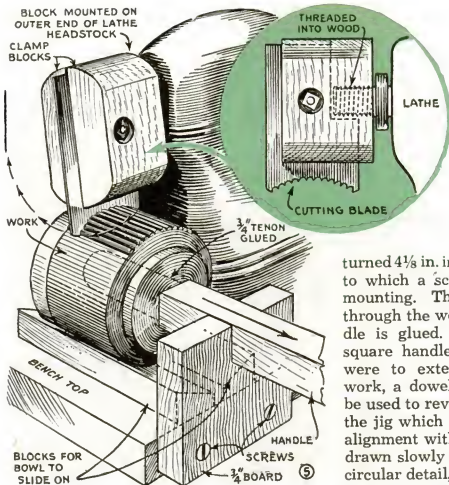
CRAFTSMAN

Novelty Turnings Reeded and Fluted On the Lathe

GIVING your lathe projects that professional touch by reeding and fluting the surface always has been a fairly simple task when it came to making such cuts around the circumference of the work, as the cuts can be made while the work is turning. But this is not the case in reeding the work lengthwise. Either a special tool, independent of the lathe, must be used, or the beads must be shaped by hand by scraping the work with a suitable cutter. However, few are equipped to do this by machine, and while the scraping method is suitable for small areas, it is a painstaking job.



With the proper setup, reeding and fluting can be done quickly on the lathe. Examples of both cross and with-the-grain reeding are combined in the turned powder bowl shown in Fig. 1. The lid is formed from a $4\frac{3}{16}$ -in. ball turning, the stock being mounted with the grain running vertically. You will notice that the reeding on



grooves in the edge with a small rattail file. See Fig. 3. After reeding the top, the balance of the ball is turned down to make the beads stand out in relief, and then one side is sanded away to leave a 3-in. flat surface which is hollowed and rabbeted to engage a matching rabbet turned in the lower section. The bottom of the bowl is

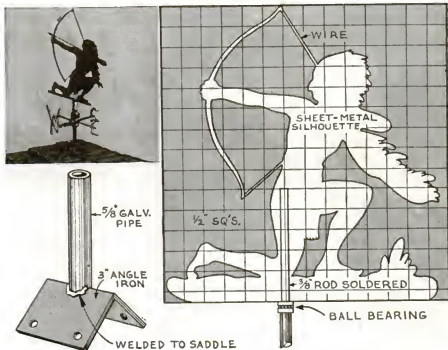
turned $4\frac{1}{8}$ in. in diameter from a 2-in. block to which a scrap block first is glued for mounting. Then a $\frac{3}{4}$ -in. hole is bored through the work in which a tenoned handle is glued. In this particular case, a square handle is used, but if the beads were to extend completely around the work, a dowel operating in a hole would be used to revolve the work. Fig. 5 details the jig which is made to hold the work in alignment with the cutter as the former is drawn slowly beneath it. As shown in the circular detail, the cutting blade is clamped in a wood head which is threaded to the outer end of the lathe headstock.

With a similar setup, table legs and stretchers can be fluted. It would be best in this case, though, to provide a guiding handle at each end of the work and to equip the jig with an indexing pin to assure uniform spacing of the cuts.

the top continues in line down the side of the bowl. In view of this, a special cutter is made and used as in Figs. 2 and 4 to cut both sets of beads, assuring matching cuts. You can make the cutter from an old scraper blade, shaping it to conform with the contour of the ball and filing $\frac{1}{8}$ -in.

Indian-Hunter Weathervane Adds a Frontier Touch

Crouching in a realistic manner atop a building, this silhouette of an Indian hunter with his strong bow, makes an ideal weathervane. The figure is cut from sheet metal and is soldered to a short rod, which fits inside a pipe welded to a short section of angle iron. A ball thrust bearing placed between the figure and the end of the pipe allows the weathervane to move in the slightest breeze. Letters on the standard indicating the directions further enhance the appearance.

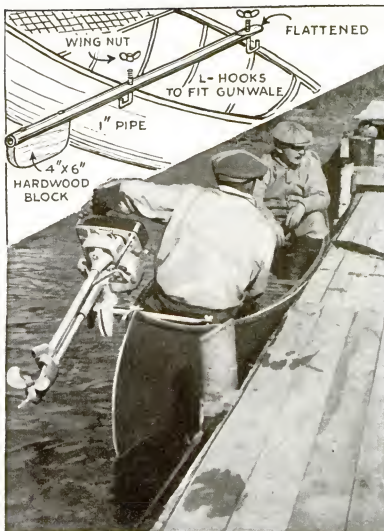


Bracket to Attach Outboard Motor to a Canoe

This simple bracket will enable you to attach an outboard motor to your canoe or kayak for swift transportation without arduous paddling. Outboard motors of $\frac{3}{4}$ to 2 hp. are sufficient for powering the average canoe. The bracket consists of a length of pipe fitted at one end with a hardwood block bolted in place to serve as a motor mount. L-hooks to fit under the gunwales attach the bracket to the boat.—Wm. Jackson, Knox, Ind.

Fishing Rods Are Stored In Eaves Trough Cabinet

In order to store his fishing rods so that anyone who wanted to could not pick them up, one camper made a cabinet from a length of eaves trough in which to lock them. End pieces were soldered to the trough, the upper one being slotted to take the rod ends for suspending them. A couple of hinges and a padlock hasp are soldered on for attaching the cabinet to the wall and locking it.



Screws Dipped in Molten Solder Not Likely to Loosen

When bolts or screws are used in wood where lock washers are impractical to keep them from loosening, dip the threaded portion in a suitable flux, and then into molten solder. A good example of using this method is a drawer pull of the type which is held in place with a screw through the drawer front, the threaded end of the screw turning into a tapped metal insert. The coating of solder on the screw threads will prevent the screw from loosening.

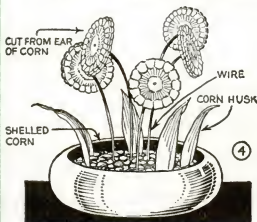


⚠ Never fasten silverware with rubber bands nor keep rubber articles near it, as this tends to darken silverware.

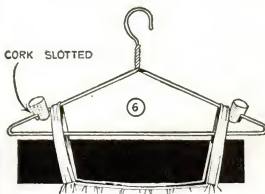
Solving HOME



When using on endless clothesline that runs on pulleys at an upper-floor level of an apartment house, sagging of the lower line is avoided by using the rolling supporters shown in Fig. 1. These make both lengths of the line carry the weight. Slipped over the thumb as in Fig. 2, a banjo pick is handy for removing basting threads from the seams of a garment

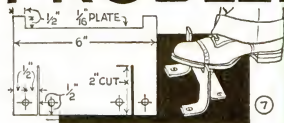


One half of a clothespin screwed to the handle of a mop as in Fig. 3 to slip over the edge of a poil, supports the mop in a vertical position. Fig. 4 shows a bouquet made of slices cut from an ear of corn and impaled on wire stems. Corn husks are used to simulate the leaves

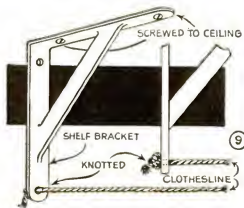


An old phonograph record file provides a handy container for paper dress patterns. A pattern is slipped into each folder of the file, after which the picture showing the style of pattern is pasted to the folder as in Fig. 5. Light garments that are difficult to keep on hangers can be held in place with corks as in Fig. 6

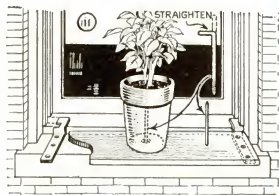
PROBLEMS



A strong shoe scraper can be made from a piece of steel plate by simply cutting and bending it as shown in Fig. 7. If you have several screens and storm sash to clean and paint at intervals, a couple of standards as shown in Fig. 8 will simplify the job. The screen pivots between them so that it can be turned over or reached from either side as required.



When screwed to the joists or ceiling of a basement, shelf brackets provide good hangers for a clothesline as indicated in Fig. 9. Difficulty of moving his lawn sprinkler into corners, flower beds, etc., while the water was on, was avoided by one householder with the cart in Fig. 10.



Hooked over the parting stops of a window, the shelf in Fig. 11, enables you to safely set potted flowers on a window sill. Long spikes or straightened L-hooks prevent any possibility of the pots slipping off the shelf. The support of iron rods shown in Fig. 12, keeps a wash boiler on a washing machine to catch garments as they are run through the wringer.



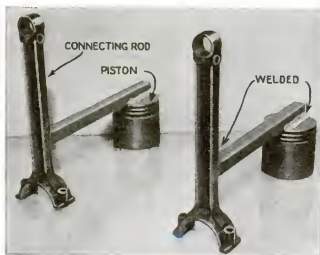
Bags Marked by Painted Labels Quickly Identified at Station



If you do a lot of traveling by train or bus, you'll save time in locating your luggage at the station if it is marked with some easily-recognizable label. Such identification marks can be put on in a few minutes by painting a circle, stripes or diamond-shaped labels on both ends of each piece. The labels will also eliminate the danger of picking up the wrong bag if there are two the same size and shape.

Fireplace Andirons Made Cheaply From Discarded Auto Parts

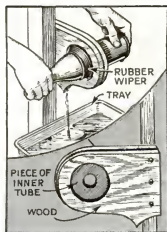
Simple but distinctive fireplace andirons can be made from two old connecting rods, pistons and a couple of iron bars 12 or 15 in. long, depending upon the depth of your fireplace. To assemble the parts, weld the



cross bars to the pistons as indicated. Then set the connecting rods and pistons on a flat surface, block up the cross bars until level and weld them to the rods.

Rubber "Squeegee" Dries Bottles

Before serving cold drinks to his customers, one owner of a roadside stand uses this rubber squeegee to dry the bottles. It consists simply of two pieces of $\frac{1}{2}$ -in. plywood cut to the shape indicated and screwed together with a piece of inner-tube rubber between them. A $\frac{3}{4}$ -in. hole in the rubber is about right for most bottles as they can be pulled through easily, to wipe off excess water.



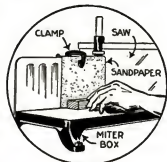
Food Packed in Grinder Safely With a Doorknob



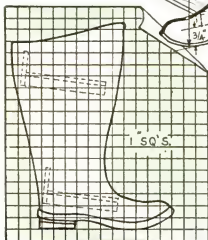
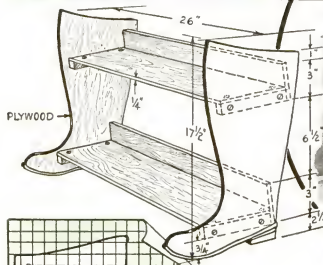
Packing vegetables or meat in the hopper of a food grinder is not a dangerous or tiresome task when a doorknob is used. If the knob is kept in a box with the grinder, it will always be at hand when needed.

Sandpaper Clamped on Miter Box Keeps Work From Slipping

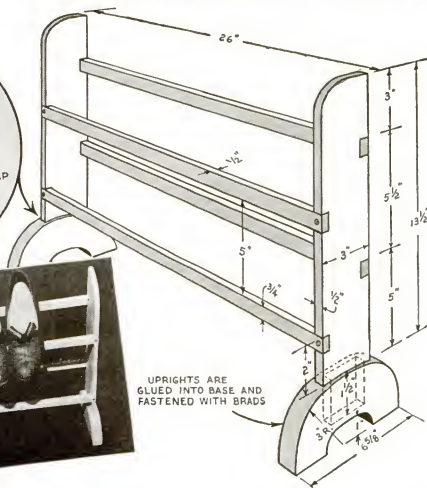
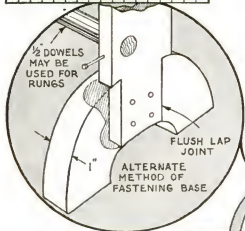
To prevent short pieces of wood from slipping under movement of a miter-box saw, fold a sheet of sandpaper over the fence and clamp it in place as indicated. By pressing the wood pieces against the paper, they will be held in place without slipping.



TWO SHOE RACKS



Stimulating tidiness in habits of youngsters and even older persons, these two shoe racks are of sturdy construction and neat appearance. The boot design can be scrollsawed from some scrap pieces of plywood, which is strong enough for little shoes, while the one detailed below is of heavier stock. If you do not wish to mortise the foot to take a tenon at the end of the side piece, a simpler method is shown at left



Practical Skirt-Length Marker From a Funnel and Cork



Measuring the length of a skirt to pin it before hemming does not require a special marking gauge. Instead, insert a cork in the neck of a funnel, force the point of a long knitting needle through the cork and adjust it to the desired height when the funnel is set on the floor.

Metal Lath Cleans Soldering Iron

You will have no trouble keeping your soldering iron clean if you use the tinning box shown. It consists of a large tin can with the base cut off at an angle as indicated. The bottom is lined with asbestos $\frac{1}{8}$ in. thick and a piece of metal lath is placed on top of this. Then the mesh of the lath is



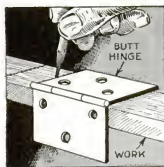
filled with sal ammoniac by grating a cake of the latter over it. After cleaning the iron thoroughly with a file, removing all pits if possible, rub it over the lath and tin in the usual way. After that, an occasional rubbing of the iron on the lath will keep it in first class condition.

Rubber Ball Helps Hook Curtains On Adjustable Stretcher

The next time you are stretching curtains, use a sponge-rubber ball to press them down on the sharp hooks. Besides preventing scratched fingers, the ball is also handy for keeping the curtain on a hook when stretching from an opposite corner.



Butt Hinge Used as Squaring Tool



I have found that a small butt hinge is frequently much handier to use than a tri-square for marking or squaring narrow work when used as indicated. For accuracy, the

hinge pin must be a snug fit so that both parts of the hinge will be in alignment.

—G. E. Hendrickson, Argyle, Wis.

Milk Cartons Serve as Paint Cups

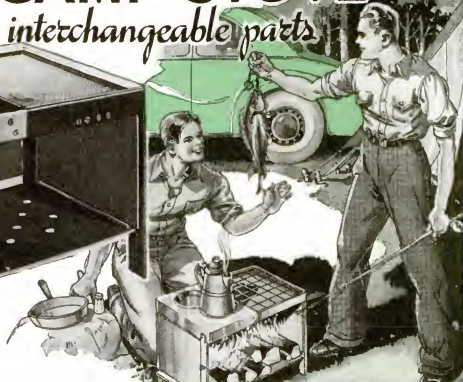
Try cutting down a cardboard milk container to the desired size, instead of using tin cups or cans in which to mix a little paint for a small job. The cartons are leakproof, and can be discarded after the job has been completed.



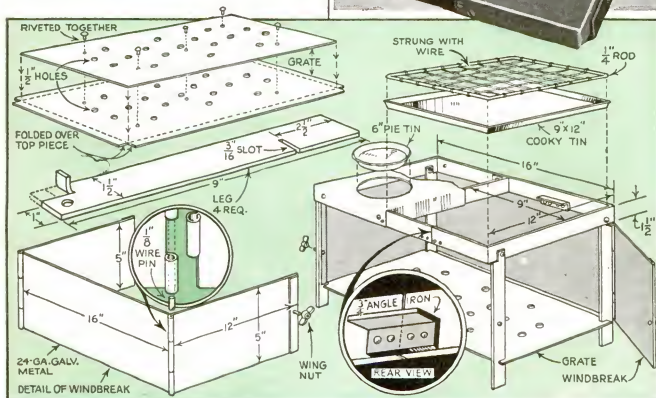
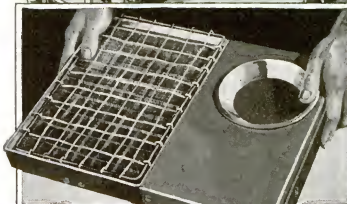
If you have a cast-iron skillet that has a grease crust on it, the latter can be burned off in a bed of hot coals.

Portable CAMP STOVE

has interchangeable parts



Folding compactly for storage or transportation, this camp stove can be set up quickly for use. The windbreak, which encloses three sides, is hinged together and is attached to the front legs with two bolts and wingnuts. Either a tray or a grill can be placed in the large open portion of the top. Similarly, a circular opening is provided to take small pie plates, while the remaining portion supports a pan or coffee pot. The legs fold flush with the top. Note that the lips at the top of the front and rear legs are bent in opposite directions



Locker House to Store Boat Oars Has Individual Compartments



A couple of boatmen solved the problem of storing oars safely by using an outdoor locker of the type shown. Instead of erecting a large structure, they built a compact 8 by 14 ft. frame building. A series of horizontal compartments large enough to hold a pair of oars and a few pieces of dunnage takes up the main portion of the house. All the compartments are arranged in rows and tiers and have doors opening in one end of the building. Besides being numbered, the door of each compartment contains an individual lock. The remainder of the space in the building is utilized as a room for a night watchman.

Mailing-Tube "Gun" Fires Balls With Speed and Accuracy



A long mailing tube and a soft rubber ball that will fit loosely inside of it can be used as an interesting gun for indoor target practice. A deep notch is cut in one side of the tube near the end. In use, drop the ball into the tube so that it may be held in place with the thumb, bring the tube to a vertical position and then strike forward with it so that the tube comes to a horizontal posi-

tion as quickly as possible. At about the angle indicated in the arc of swing, raise the thumb and the ball will fly out of the tube at high speed. Accuracy of firing is a matter of practice, of course, but it can be developed to a surprising degree.

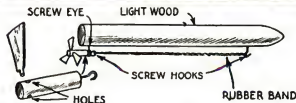
Tree Branches Stabilize Canoe For Still Fishing

To avoid having his canoe capsize unexpectedly, when slow-trolling or still-fishing, one sportsman lashes two fully-leaved tree branches to the stern of the craft. These act as a stabilizer without preventing necessary operations of the paddle, and may be cut away and discarded when not needed.

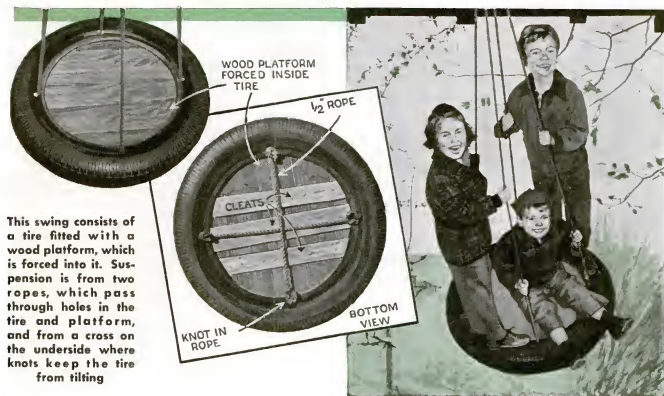


Toy Torpedo Driven to Target By Rubber-Band Motor

With this torpedo and a toy ship or two, you can stage a regular sea battle. When launched with its propeller spinning, the torpedo approaches its target in a realistic manner. A screw eye serves as a bearing for the propeller, and two small screw hooks take the rubber band, one being driven into the end of the propeller shaft, the other near the front of the torpedo.



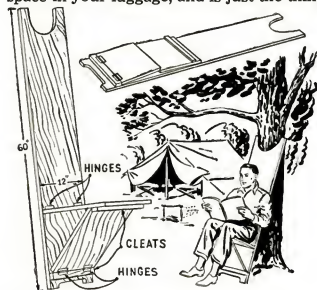
Platform Tire Swing Is Safe for the Children



This swing consists of a tire fitted with a wood platform, which is forced into it. Suspension is from two ropes, which pass through holes in the tire and platform, and from a cross on the underside where knots keep the tire from tilting

Three-Piece Folding Camp Chair Leans Against a Tree

This chair requires very little storage space in your luggage, and is just the thing

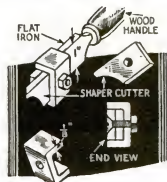


for those who frequently go on picnics, or short camping and fishing trips. It is especially handy when several persons must go in one car, and luggage space is limited, as it folds flat so that two or three chairs can be carried on a fender or running board. The chair is made from a 1 by 12-in. board, which is cut out at the top to fit against a tree trunk and prevent tipping. Also, the bottom is cut to provide feet. The seat and its supporting brace are hinged in place so that they will fold flat. Screwing the brace hinges to a cleat spaces it from the chair back to permit folding. When the chair is opened, the end of the brace engages a cleat at the outer end of the seat to keep the assembly from collapsing.

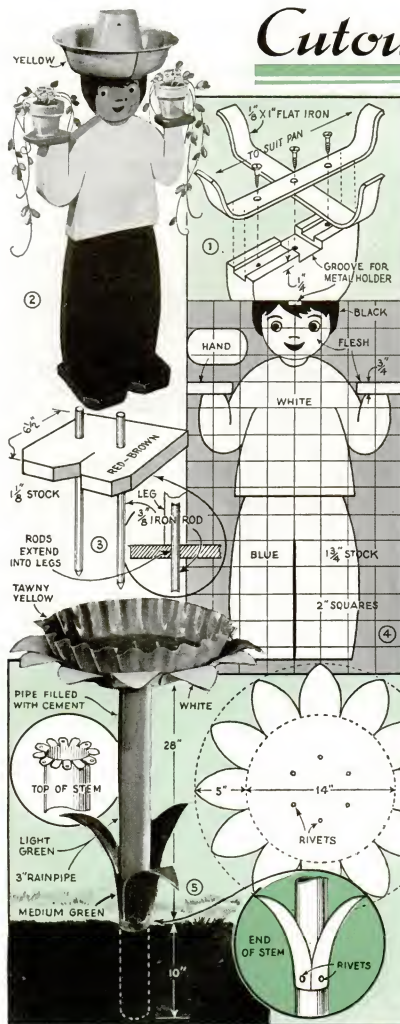
—M. B. Birge, Rochester, Minn.

Turning Chisel Has Removable Cutting Blades of Various Shapes

Instead of having a variety of expensive turning chisels on hand, one woodworker who does considerable intricate lathe turning made up a holder to take shaper cutters, which he used as turning chisels. The cutters can be obtained in a variety of shapes, and are made of high-grade steel, which will not dull quickly. The holder is a piece of flat iron with one end ground down to form a tang, which slips into a wooden handle. The cutter is attached to the holder with a machine screw, which passes through the cutter, holder and a U-shaped clamp that fits over the assembly to keep the cutter from twisting sideways.



Cutout BIRD

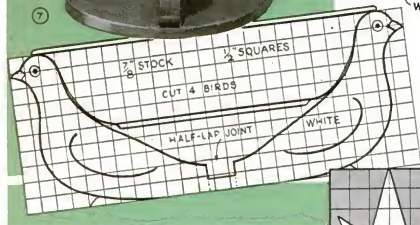


THESE novel, decorative bird baths, which are easily made from ordinary materials, will add charm to any garden or lawn. For best effects choose a spot away from the house against a background of shrubs, since a bird bath not only looks best in a setting like this, but will be more attractive to birds. The location should be shaded at least part of the day, as the water in small pans will evaporate quickly if left in the sun continually, and the paint will not stand up through a season of blistering sun.

The sombrero on the little Mexican chap is really a wash basin with an inverted flower pot set in it to simulate the tall crown. Figs. 1 to 4 give all the details. A potted plant is held in each hand. The basin is held by two crossed pieces of flat iron. Bend these to the shape of the pan and set into grooves cut in the head, so that the top one rests flush with the top of the head. Fasten with three screws. This arrangement al-

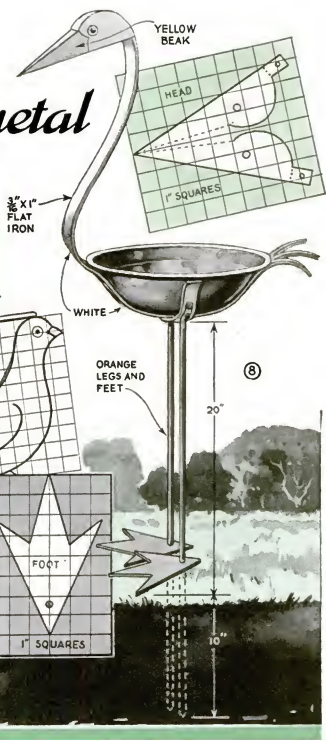
BATHS

of wood and metal

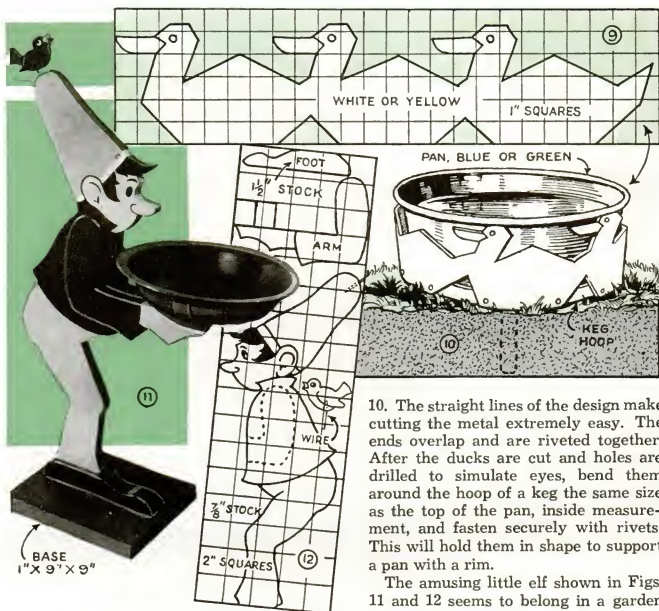


lows the pan to be removed for cleaning and filling. Screw the hands and feet in place and drill a hole through each foot and up into each leg for a distance of several inches. Then insert metal rods extending about 10 in. below the base. When these are pushed into the ground, the figure will be held securely.

The huge flower, Figs. 5 and 6, from which the birds may drink, is made entirely of sheet metal and resembles a giant daffodil. The crinkled-edged water pan is nothing more than a hog-feeding pan. The petals are cut from galvanized sheet iron and the stem is a length of rain-pipe, filled with cement. The disk holding the pan is scalloped to form petals. Set the pan inside and bend up three of the petals to hold the pan securely, turning over the tips. Then remove the pan and bend the other petals uniformly as shown. The top of the rain-pipe stem is serrated and bent so that it can be riveted or soldered to the bottom of the petal piece. Cut three sheet-metal leaves and bend the lower ends to fit around the pipe. Rivet them in position and then bend the tips over. Paint each part before assembling.



Birds may bathe safely in the bath held by four doves, Fig. 7, if your neighborhood is free from prowling felines. It is especially suitable for small, informal gardens or a secluded corner of a large one. While a pan used originally was 11 in. in diameter and 2 3/4 in. deep, the design may be altered for pans of other sizes. The two pieces are half-lapped at the center, glued and nailed, then attached to a round base about 9 in. in diameter. If desired, however, the base may be mounted on a suitable pedestal. The doves are white, the feet, bills and outline of the wings purple, while the base is a deep green or reddish brown. The pan is light green and the eyes



are a couple of black or red thumbtacks.

The long neck and legs of the crane, Fig. 8, are formed from flat iron, the feet and head from sheet metal. The body is a water basin. Point the end of the neck piece to make the top of the bill and bend the piece to the contour of the basin. Then split the other end to make a tail. Shape another piece of iron to extend just to the rim of the pan, place it across and under the first piece and rivet them together. Use iron rods for legs, flattening and bending them to join the crosspiece, to which they are riveted. Cut the head from galvanized sheet metal, bend it to fit over the beak and rivet the tabs at each side to the back of the neck. To hold it even more securely, a stove bolt may be run through the eyes. The legs are pushed through holes in the sheet-metal feet and extend into the ground.

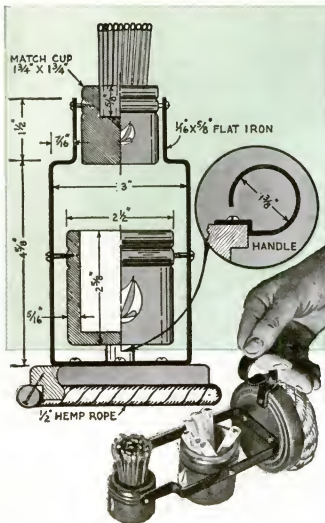
Ducks swimming in "single file" support the low bird bath as shown in Figs. 9 and

10. The straight lines of the design make cutting the metal extremely easy. The ends overlap and are riveted together. After the ducks are cut and holes are drilled to simulate eyes, bend them around the hoop of a keg the same size as the top of the pan, inside measurement, and fasten securely with rivets. This will hold them in shape to support a pan with a rim.

The amusing little elf shown in Figs. 11 and 12 seems to belong in a garden surrounded by birds and flowers. A wooden bird is perched atop his tall cap, and in his outstretched arms he holds a small basin for water. A piece of heavy wire holds the bird in place. Nail the arms on the body, with a strip of wood between the parts that extend. Attach the feet and then screw them to the base. Drill a hole through it and into the leg to take a rod for anchoring the figure to the ground. The cap and trousers of the model were painted green; the jacket, shoes and the bird were rust color; the pan greenish blue, the hair black and the base a deep green.

As painted objects, especially those done in bright, gay colors, have a tendency to fade soon, it is best to use outdoor paints recommended as having "fast" durable colors. Also, outside pieces such as these should be given two or three coats of paint and a finishing coat of spar varnish to withstand the weather. Of course, garden ornaments always should be stored inside during the winter months.

There's Swing to This Novel Cigarette Holder



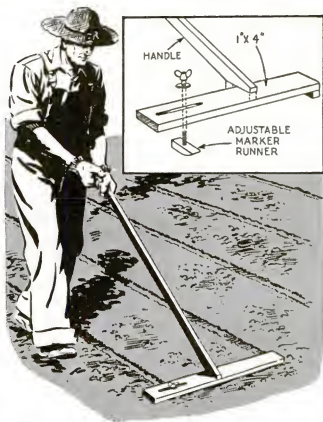
Nautical in trim, this handy little smoking set has cigarette and match containers of wood pivoted for ease in offering and taking the contents. Small ships cut from thin sheet brass or plastic are bradded to the lower container and the base is bound with rope, while a small finger-and-thumb hold projects from the edge. The metal parts may be flat iron or brass

Marker Spaces and Furrows Seed Rows in One Operation

This vegetable-row marker will save work in the garden as it spaces the rows and furrows them at the same time. In this way, small seeds are spaced properly and can be covered to a uniform depth. The marker is simple to make. It has two runners, one being adjustable and is held in place by a bolt working in a slotted cross-piece. The other runner is fixed, its purpose being merely to serve as a guide in spacing the rows as it follows along in the furrow previously made.

WHAT HAVE YOU DONE?

Have you solved some troublesome everyday problem of a mechanical nature pertaining to your home, work or occupation, your hobby, play or recreation? If so, why not send us a short description accompanied by a sketch or a photograph? Many other readers may benefit from what you have done. We pay promptly for accepted material and return that which we cannot use. Address: Homecraft Editor, Popular Mechanics Magazine, 200 E. Ontario Street, Chicago, Illinois.



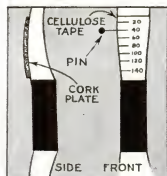
Rubber Guards on Hedge Shears Prevent Scratched Hands



To protect his hands from scratches while trimming thorny hedge or bushes, one home owner fastens rubber guards on the shear handles as shown. Sections cut from an old inner tube are ideal for the purpose. They can be secured to the shear handles by wrapping wire around one end of them and twisting it to draw the rubber tight.—Everett Hanson, Argyle, Wis.

A Versatile Homemade Bow Sight

This simple, lightweight device has all the adjustable variations of an expensive bow sight, and with an average weight bow



is fairly accurate for distances well over 100 yards. Cut from a strip of cork gasket material 1 in. wide by 6 in. long, the sight is fastened with adhesive tape to the back of the bow just above the leather grip. After gluing the cork in place, put a strip of cellulose tape on the belly of the bow opposite the cork. Stick a 2-in. round-head hat pin into the cork so that the head projects $\frac{1}{2}$ in. beyond the left edge of the bow. Then, by the trial-and-error method at various distances, de-

termine the proper position of the pin for each distance and mark these positions in ink on the tape, numbering them accordingly. A coat of clear shellac will protect both the cork and the scale.

Magnet Removes Tin-Can Tops

When using a can opener of the rotary type where the lid has a tendency to drop down inside the can after it has been cut away, you will find a small magnet handy to hold a lid. When the latter has been almost cut away, just place the magnet against it and then complete the cutting, after which you can lift it up.



—W. C. Wilhite, Carlinville, Ill.

Piece of Candle Used as a Stopper In Glue Bottle

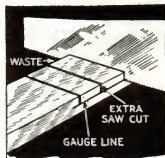


If a piece of candle is used in place of the regular cap or cork in a bottle of glue or mucilage, it will exclude air from the contents and will not stick and be difficult to remove.

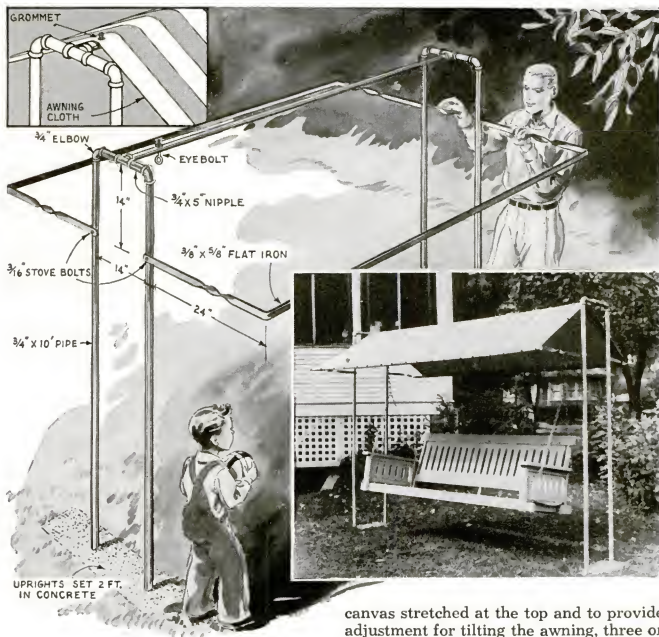
It's a good idea to taper the end of the candle by dipping it in hot water so that it will slip into the bottle mouth easily.

Extra Cuts Aid in Waste Removal When Making Half-Lap Joint

When making a wide half-lap joint or when cutting long tenons by hand, you can remove the chips to uniform depth with ease if you make one or more extra cuts in the waste stock. As many as two or three additional saw cuts down to the gauge lines will be found especially helpful when the wood is crossgrained.



Pipe Swing Support Has Awning for Shade



An awning-covered frame that is rigid and strong enough to support a lawn swing can be made of galvanized pipe and fittings. When assembling the frame, screw the elbows and tees together first, then screw these units onto the horizontal piece, and last, turn the four legs or uprights in place. The flat-iron awning supports are pivoted to the legs after the frame has been set in the ground. Hooks from which the swing is suspended with chains, are ordinary eyebolts that can be purchased at any hardware store. The awning is made of lightweight canvas, and has a selvage or hem at each end and a 2-in. hem at the sides. The latter take the flat-iron arms that hold the awning. The finished awning, without allowance for seams and hems, should be 6 by 7 ft. in size. To keep the

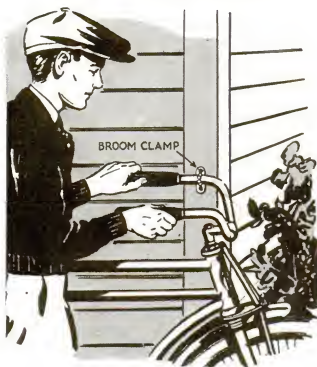
canvas stretched at the top and to provide adjustment for tilting the awning, three or four grommets are placed in a row near each edge of the canvas to slip over the projecting ends of the eyebolts in the horizontal pipe.

Self-Extinguishing Camp Candle

To leave his candle burning so that it will safely extinguish itself at any estimated time, one camper inserts the candle in a tin can and presses the cover against it to hold it erect. As soon as the candle burns down to the cover, it drops into the can, which is partly filled with water.



Broom Clamp Supports Bicycle Against Side of House



Instead of leaning your bicycle against the house where it may fall and become damaged, attach a broom clamp to the siding or corner board so it will grip one of the handlebars when the bicycle is in an upright position. It takes only a light jerk to release the handlebar from the clamp.

Film Spools Make Fishline Reels



Needing some reels for extra fishlines, one camper used empty film spools. Each flange of a spool was bent up at right angles on opposite sides to provide a channel.

Springy Perch on Wren House Discourages Intruders

While most birds are too large to enter the opening to a wren house, which needs no perch, they do sometimes attempt to enter and may annoy the



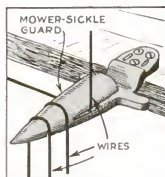
wrens. To discourage this, one man provided a perch, which consisted of a short dowel on the end of a short spring wire. As the perch was not strong enough to support a heavier bird, intruders in trying to alight on it were frightened away.

Section of Radiator Hose Protects Fisherman's Reel

To protect his fishing reel from damage when the rod was being carried in a car or boat, one sportsman cut a short section of radiator hose, to fit over it. The hose is easily removed or replaced.



Mower Sickle Guard Used as Anvil For Modelmaker

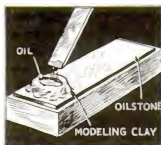


Screwed to the edge of a bench or table, a mower sickle guard provides a handy anvil for shaping wire in model work. The wire can be shaped into arcs or rings of various sizes over

the tapered end of the guard, or it can be bent at sharp angles when placed in the slot. Remove the guard when not in use to avoid injuring yourself on the point.

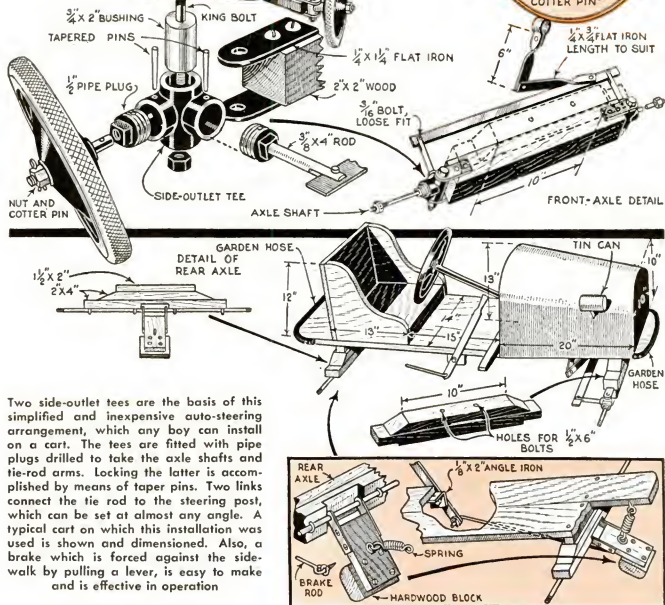
"Well" Made of Modeling Clay Stores Oil on Stone

To keep oil conveniently at hand, when using the oil stone, one carpenter makes a well of modeling clay near one end of the stone to receive the oil. Tools may be dipped into the oil as needed and there is no appreciable waste as is the case when oil is squirted onto the flat surface.



Simplified AUTO STEERING

on Junior's
Sidewalk
Car



Two side-outlet tees are the basis of this simplified and inexpensive auto-steering arrangement, which any boy can install on a car. The tees are fitted with pipe plugs drilled to take the axle shafts and tie-rod arms. Locking the latter is accomplished by means of taper pins. Two links connect the tie rod to the steering post, which can be set at almost any angle. A typical car on which this installation was used is shown and dimensioned. Also, a brake which is forced against the sidewalk by pulling a lever, is easy to make and is effective in operation

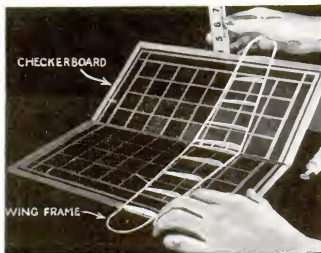
Lawnmower Hung on Side Wall Out of the Way



By nailing two notched cleats to one of the studs of a garage or toolhouse wall as indicated, you have means of storing your lawnmower where it will take little room. If the upper edges of the cleats are rounded as shown, you can push the mower into position instead of lifting it.

Wing Dihedral of Model Airplane Determined With Checkerboard

The dihedral angle necessary for the wings of small flying airplane models can be determined easily with the aid of a folding checkerboard. Just pin one half of the wing frame securely to one half of the board. Then raise the opposite half of the



board to the desired dihedral height in inches as measured on a ruler. Block and hold the board securely in this position. Then cement and brace the wing framework through the center so that it will retain the dihedral shape when removed from the board.

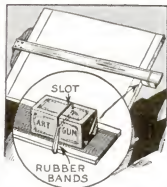
—Ray J. Marran, Kansas City, Mo.

Pocketknife Holds Model or Toy For Painting and Drying

Small wooden models or toys can be painted without touching them, if a pocketknife is used as a holder. Open the blades as shown, insert one point into the model and the other into the table.



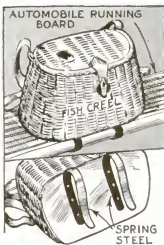
Non-Slip "Brake" for T-Square From Art-Gum Eraser



A brake to prevent a T-square from slipping down a tilted drawing board is made from a block of art gum. Attached to the square with rubber bands, it bears against the board.

Spring Clips Fasten Fish Creel On Auto Running Board

To provide a means of carrying his creel of fish home without putting them inside the car, one fisherman riveted two spring-steel clips to the creel so it could be slipped over the running board. In this way, the fish odor does not enter the car.



Things to make from RAFFIA

Hot-dish
pad



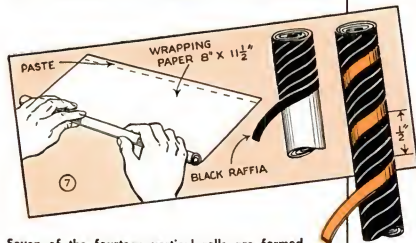
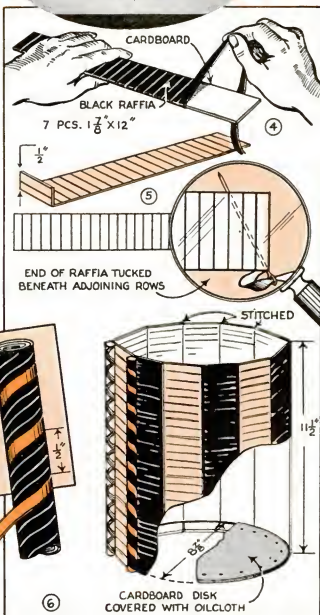
Purse



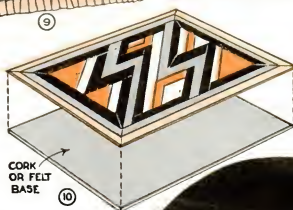
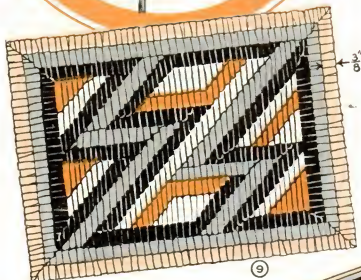
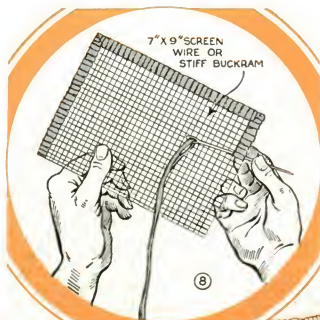
Wastebasket

By H. Lemberger

RAFFIA need not be restricted to basket-making alone. You'll find the material suitable for weaving many other useful articles such as hot-dish pads, attractive overlays for hand bags, coin purses, wastebaskets, etc. Figs. 1, 2, 3 and 11 show a few examples of what can be done. The wastebasket is made up of fourteen panels of fairly stiff cardboard. Each one is wrapped with raffia as in Fig. 4, seven of them being covered in black and seven in yellow. Before covering, each strip is scored with a knife $\frac{1}{2}$ in. from one



Seven of the fourteen vertical rolls are formed from sheets of paper 8 by $11\frac{1}{2}$ in., while the others require $11\frac{1}{2}$ by 16-in. pieces. Each one is completely covered with raffia and then wrapped spirally with a single strand



The mat is completed by gluing cork or felt to the bottom. Cut this slightly smaller in size and press flat under a heavy object until dry

end so that it later may be bent inward easily to form a tab for the bottom. The wrapping is begun at the end opposite the score, using a little paste to secure the starting end. Let each turn overlap slightly the edge of the preceding one, and when the end is reached, the raffia is pasted and tucked under the winding as in Fig. 5.

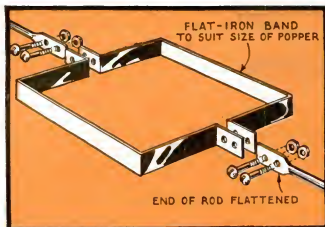
With the tab ends all facing inward, the panels are sewed to one another with black thread, alternating the position of the two colors. The stitches are made through several rows of raffia the full length of the strip, but not through the cardboard. Now paper rolls are made to

cover the seams as in Fig. 6. First, sheets of wrapping paper are rolled tightly into a firm roll and pasted along the edge. Seven of these rolls are fully wound with black raffia, after which a single strand of red raffia is wrapped spirally over the black the full length of the roll as in Fig. 7. The seven other rolls are done in yellow raffia and then wrapped with a double spiral of red—that is a second strand is wound spirally in a reverse direction from the bottom to the top. In sewing these over each seam of the basket, use small stitches to catch hold of the raffia, and alternate the colors, placing first a black one, then a yellow and so on. Finally, a cardboard disk with black oilcloth glued to the top is sewed to the tabs at the bottom.

The hot-dish mat shown in Fig. 1 may be woven on a piece of common screen wire, or stiff buckram. If the former is used, trim the marginal ends of the wire close to the mesh. First, a double row of stitches about $\frac{3}{8}$ in. wide are overcast around the edge of the mat, using a tapestry needle as in Fig. 8. After this, the center portion is filled in, following the direction of the weave given in Fig. 9, and finally the finished mat is glued to a felt or cork base, Fig. 10.



Spit to Roast Several Wieners At One Time



The next time you have a large wiener roast, this spit will handle enough sausages to serve several people at a time. It consists of a screen-wire corn popper fitted with a flat-iron frame, which is bolted to the flattened ends of a couple of iron rods. In use, the spit is supported above the fire on a couple of forked sticks, or on one stick and an iron stake with an eye in the upper end. The



spit comes apart easily so it can be stored in your automobile or picnic luggage.

Friction Catches Used As Pivots on Easel Picture Frame

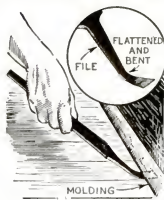
Instead of using screws and washers in assembling easel-type frames, one woodworker substitutes small friction catches.



These are fitted to the inside of the vertical members and snap into corresponding holes in the frame. The fasteners are hidden from view, yet permit the frame to be adjusted to any desired angle. Furthermore, the frame can be removed from the holder whenever desired.

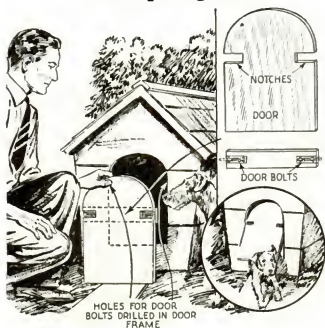
Tool Pries Floor Molding Loose

When I have to remove the quarter-round molding of a floor to lay linoleum, I use a tool made from an old file to pry it loose. The tang of the file is flattened and bent in the shape indicated, after which it is hardened slightly. With a tool of this kind it is no job at all to remove the molding without splitting it.



—Paul Fairbanks, Milwaukee, Wis.

This Kennel Door Is Removable To Keep Dog Cool



Instead of propping a kennel door open to give a dog air during hot weather, provide it with this easily removed door. It is suspended by means of door bolts as indicated, so that the dog can push it in or out as desired, and is removed by simply sliding the bolts back and lifting it out.

—Anthony Wallace, Shenandoah, Pa.

Drawing "Inked" by Steaming

A simple way to ink drawings is to do the work with an indelible pencil, double tracing the heavier lines, and then steam the drawing over a teakettle. Although the lines made by an indelible pencil are too



light for easy reading, the moisture from the steam turns them a dark purple without smearing or getting the paper too wet.

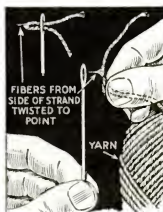
—L. K. Ulery, San Diego, Calif.

Making Corks Easy to Remove From Insulated Bottles

The cork of an insulated bottle can be removed easily if a string is put around the cork from top to bottom as indicated, cutting a small notch in the lower edge to receive it. The string is tied at the top to form a loop in which to insert the finger when the cork is to be pulled out.



Easy Way to Thread Heavy Yarn Through Darning Needle



Difficulty of threading heavy yarn through the eye of a needle may be avoided by rolling a few of the fibers at one side of the yarn to a point instead of trying to roll the end. This small portion of yarn can then be inserted into the needle eye, after which the main strand can be pulled through.

inserted into the needle eye, after which the main strand can be pulled through.

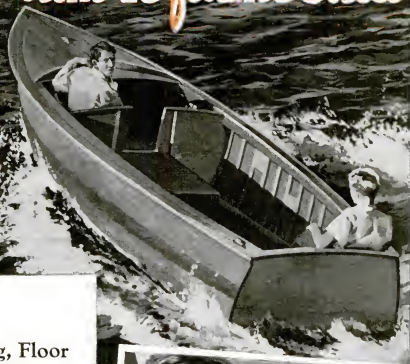
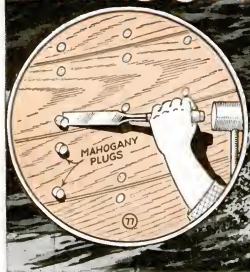
Elastic in Wrist of Work Glove Makes Snug Fit Around Arm

When you purchase a pair of work gloves that have knitted wrists, sew a piece of elastic onto them as indicated. This will keep the wrists from



stretching so that they do not make a snug fit around the arm and allow cold air to enter.—W. C. Lammey, Naperville, Ill.

"FALCON" trim 18 ft. Inboard



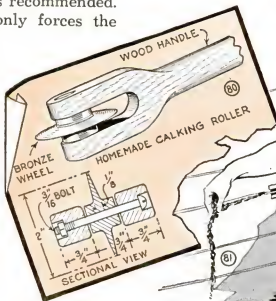
Part IV

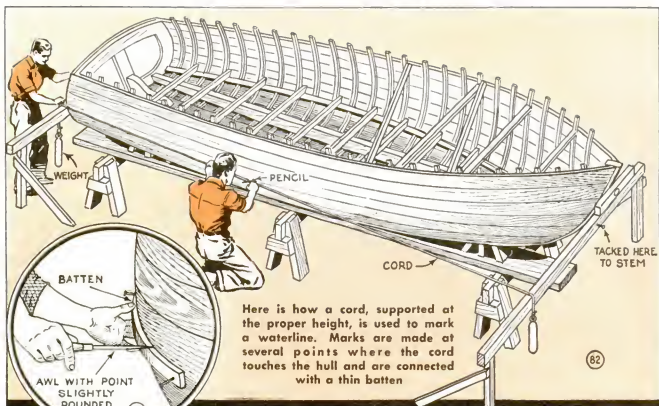
Bilge Stringers, Shaft Log, Floor Timbers, Deck Beams, Decking

WHEN the final shutter plank is fitted, you cap the countersunk screws with $\frac{3}{8}$ -in. mahogany plugs which are coated with marine glue and tapped snugly in place. The grain of the plugs should run parallel with that of the planking. When dry, the ends are sliced off as in Fig. 77, and sanded down flush.

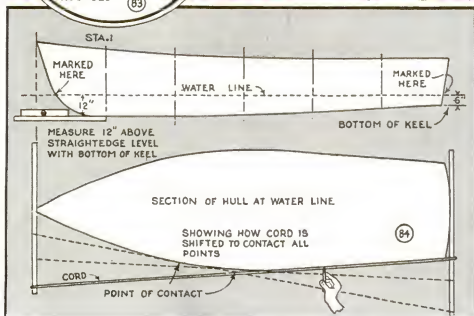
Before calking the hull, the planks are planed down at the seams where necessary to get a uniformly rounded contour. Use a hand plane as in Fig. 79 or a spoke shave as in Fig. 78. For packing cotton candle wicking in the seams, a bronze roller detailed in Figs. 80 and 81 is recommended. The tapered wheel not only forces the wicking snugly in place, but it will also open tight seams, giving them the desired wedge shape. A single strand of wicking, applied dry, is sufficient between the planks, possibly more at the rabbet line of the stem.

Figs. 82 and 84 show how a temporary water-line is marked as a guide for painting. After a cord is stretched taut by sash weights, it is brought





Here is how a cord, supported at the proper height, is used to mark a waterline. Marks are made at several points where the cord touches the hull and are connected with a thin batten



against the boat, where pencil marks are made to indicate the temporary waterline. The true waterline is determined when the boat is launched, fully equipped. When this is found, it should be scored deeply as in Fig. 83, to be visible under paint.

The 1 by 1½-in. bilge stringers are located as in Fig. 85 with the aid of a straightedge and a small block. The ribs between the transom and stem are marked and the stringers are screwed to each rib in line with the marks. The stringers are not beveled and will appear as in Fig. 86. Then the bottom of the hull between the bilge stringers is painted. Fig. 87 shows this area just painted.

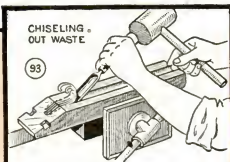
Laying out the angle of the shaft with the keel requires extreme accuracy. The pattern should be taken directly from the full-size hull lines previously drawn. (See Part I, Fig. 2.) On these lines the centerline of the propeller shaft is located as in Fig. 90, and also the line representing the top of the keel. To transfer these lines to a 12 by 30-in. piece of plywood, nail heads are used as described in the first installment for the hull molds. If carefully laid out, you should have a pattern like the one shown in Fig. 88. This is notched and placed on the keel so both centerlines coincide as in Fig. 89. From this pattern the profile of the shaft log is marked on a 3½-in. mahogany block, Fig. 91, after which it is cut in two pieces along the propeller-shaft centerline to correspond with the dimensions given in Fig. 92. Notches are cut ½ in. deep in each side to house the ends of the three divided ribs.

Saw cuts in each half of the log as shown in the circular detail of Fig. 94, and gouged out as in Fig. 93, simplifies roughing-out



SHAFT LOG MARKED OUT FROM PATTERN ON PHILIPPINE MAHOAGANY

(91)

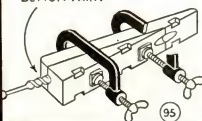


CHISELING OUT WASTE

(93)

Above, after roughing-out on the saw, the waste is removed with a gouge. Then the pieces are clamped together to true up the hole with a bit as shown below

BORE PAINTED WITH COPPER BOTTOM PAINT

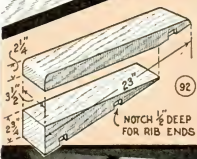


(95)



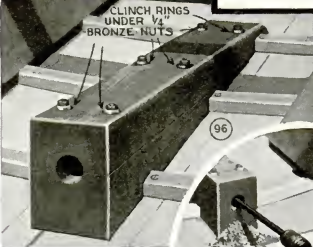
(94)

SAW CUTS MADE INSIDE $\frac{1}{8}$ " CIRCLE ON BOTH PIECES OF LOG



(92)

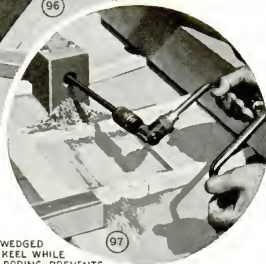
NOTCH $\frac{1}{8}$ " DEEP FOR RIB ENDS



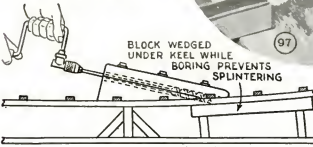
(96)

CLINCH RINGS UNDER $\frac{1}{4}$ " BRONZE NUTS

The log is used as a guide in boring the shaft hole through the keel

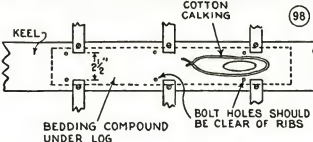


(97)



BLOCK WEDGED UNDER KEEL WHILE BORING PREVENTS SPLINTERING

(98)



KEEL

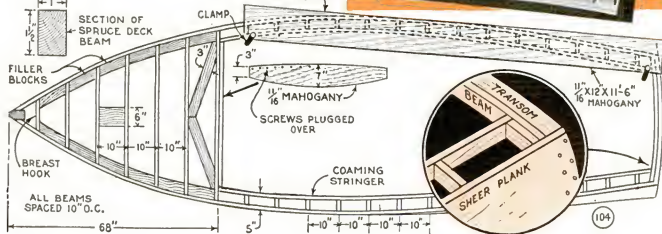
COTTON CALKING

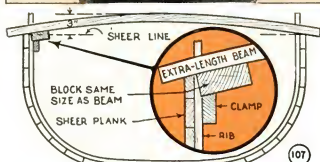
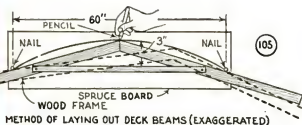
BEDDING COMPOUND UNDER LOG

BOLT HOLES SHOULD BE CLEAR OF RIBS

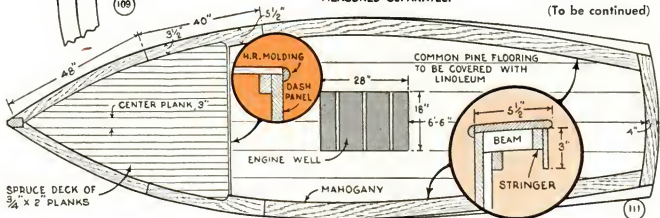
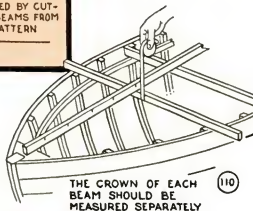
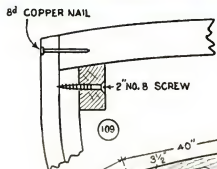
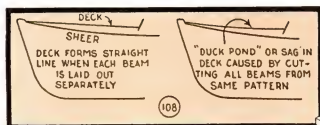
to prevent the bit from breaking through. Now apply bedding compound between keel and shaft log, lay a strand or two of candle wicking around the hole in the keel and bolt the log in place, using clinch rings under the nuts, Fig. 96. The $1\frac{1}{2}$ by $1\frac{3}{4}$ -in. floor timbers are supported by the engine and bilge stringers, and are copper-nailed to every other rib as in Figs. 99, 100, and 102. One stringer is divided to provide space for the engine well, the size of which must suit the engine being used.

The spruce deck beams are next. Lay out each one separately to avoid a "duck pond" as in Fig. 108. To get the proper crown of each beam see Fig. 105. A light V-shaped frame is used to bear against nails driven in the spruce stock. By holding a pencil at the apex of the frame as the latter is moved around from one nail to the other, the proper curve for that particular beam will be drawn. Repeat this for each beam, varying the distance between the nails, as well as the pitch of the frame. Each individual pitch is found by measuring each beam





DETERMINING BEVEL OF CLAMP AT EVERY OTHER RIB



sheer planks and marked at each end of the beam along the inside of the sheer planks. Then the beam is placed across the sheer right side up, but reversed end for end. A small block is held vertically in contact with the inside of the sheer plank and in line with the mark previously made to mark the end of the beam for cutting. The beams are fastened with copper nails driven through the sheer planks, while a single bronze screw is used to attach the clamp to each rib as in Fig.

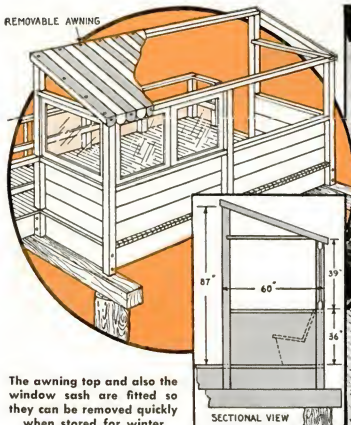
109. The cockpit-coaming stringers are braced every 10 in. as in Figs. 103, 104 and 111. A 3-in. mahogany facing is finally added to the stringer flush with the top.

A final check of the deck beams is made as in Fig. 106, and then the covering board is added. Fig. 104 shows how it is clamped temporarily for marking. On the inside it is marked so that it overhangs the coaming facing $\frac{1}{2}$ in. long are used to fasten it, and are countersunk and plugged. Fig. 111 shows the arrangement of

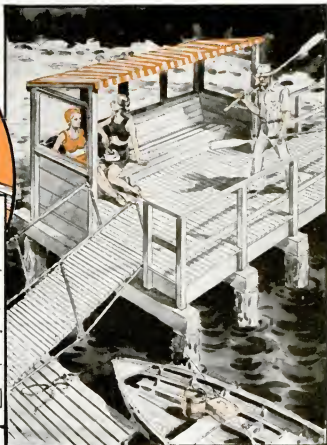
the deck planks which also are beveled and calked, and the flooring. As shown in Fig. 101, the floor boards, with the exception of the two center ones may be fastened in place with nails.

(To be continued)

Glazed Shelter on Pier Has an Awning Top



The awning top and also the window sash are fitted so they can be removed quickly when stored for winter



Protected from the wind by glassed-in walls, and from the sun by a detachable awning when it becomes too warm, this retreat is an ideal spot to lounge between fishing or sailing cruises. The structure can be erected on any substantial pier, the principal requirement being to fasten the uprights securely to the pier stringers. Unless you have the windows on hand, se-

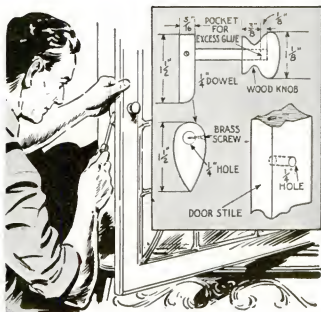
lect them from your dealer before laying out the structure so that there will be as little trimming as possible. In other words, build the shelter around the windows. The awning can be fastened by means of grommets, and it can be stored in lockers under the shelter seats when not in use. The lockers also accommodate oars, sails and other sea-going paraphernalia.

Wooden Latch to Match Antique Cabinets and Cupboards

Needing a knob latch for an antique cabinet that he had repaired, one craftsman made one as shown. It consists of a wood knob glued to a short dowel, which passes through a hole in the cabinet-door stile and has a wooden catch screwed and glued to the end. When the door is closed and the knob turned, the catch is moved so that it projects behind the door frame.

—Robert Stahler, Portsmouth, Ohio.

❏ To renew the seal in small jar lids, cut disks of the required size from empty cardboard milk containers. These will be just the right thickness, are well waxed and will serve the purpose much better than several layers of ordinary waxed paper.



Stretcher Leaves Both Hands Free While Upholstering Chair



This stretcher is operated by the foot when putting webbing on the bottom of a chair so that both hands are free to drive tacks. The chair must be propped up to a good working angle.

Flashlight Cap Used as a Swab

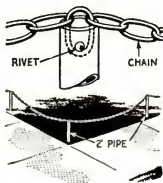


When applying liquids with a swab, and you do not wish your fingers to come in contact with the liquid, just roll up a strip of cloth and

insert it into the bottom cap of an old flashlight as indicated. The cap is not suitable for use in strong acids, as they will soon eat off the copper spring.

Fastening Chain to Pipe Posts To Protect Small Lawns

When using chain and lengths of pipe to construct a simple fence around a small plot of ground, you can fasten the chain to the pipe stakes securely by the



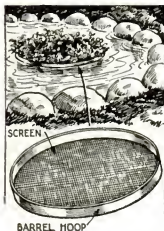
method shown. Each stake is drilled through near the upper end. Then one chain link is inserted into the stake to extend below the hole. A rivet or small bolt through the latter secures the chain.

Most-Used Key Identified Easily When Isolated on Chain

If you have one key on your chain that you use more than any of the other keys, arrange it on the chain as shown in the drawing and you can pick it out easily in the dark. Just run both sides of the chain through the most-used key, dividing the other keys equally on both sides.



Plants in Pool Are Segregated With Screened Barrel Hoop



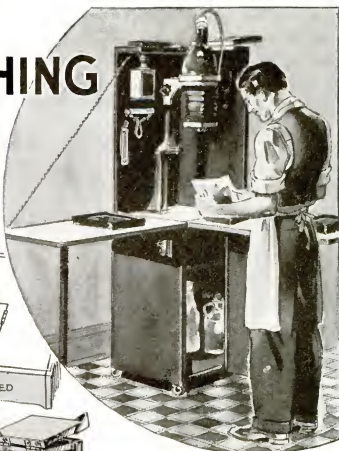
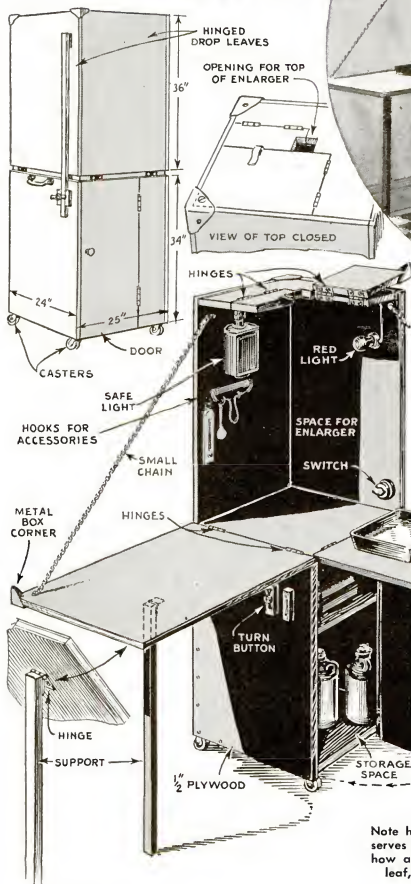
Plants in a garden pool can be kept from floating around over the entire surface by placing them on this "floating island." It is a barrel hoop with screen wire stretched tightly over it and tacked in place.

Interchangeable Slide on Scale Marks Side Being Used

To mark the side of his triangular scale being used so that he would not have to turn it over every time he picked it up, one draftsman made this slide. The slide is interchangeable to any two sides of the rule, and is held in place by a couple of friction catches as indicated in the drawing.



Compact PHOTO-FINISHING CABINET



Your entire darkroom with all of its equipment can be folded up to form a compact cabinet which takes little space in the corner of a room, and can be locked if desired. Casters permit moving it easily to a position near a sink. Two sides are hinged at the center and drop down to provide "tables," while a corner section of the top swings back to give clearance for an enlarger

Note how the door of the cabinet below serves as a support for one drop leaf and how a single leg is hinged to the other leaf, in addition to the use of chains

GETTING GOOD PHOTOS *around*

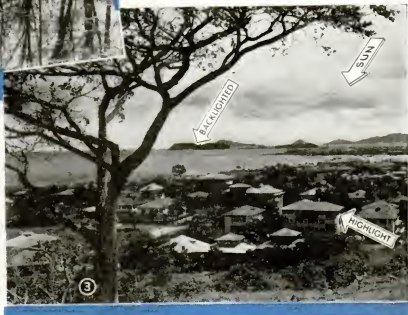


lighting used in this way often produce remarkable effects.

Sunlight is not always necessary to obtain good photos around water. Photo 2 was taken on a day when the sky was overcast to completely eliminate shadows. This is the time to take pictures in which reflections play an important part. At such

By Thomas P. Lake

THE photographer who gets good photos around water must know how to handle reflections and contrasts. While water is usually considered to have characteristic reflections, there are conditions under which water is black and apparently without reflections. This is the time when it may become an effective background as in photo 1. Close behind the canoe is a dark forest which cuts off bright reflections. The sun is low and to the right, providing strong sidelighting for the occupants of the canoe. Dark backgrounds and strong side-



times lighting is soft and the reflection becomes correspondingly important. The reflection of sky in the water brings out the shadow of the bridge and thus tends to emphasize the latter. If this picture had been taken on a sunny day, an exposure

WATER

short enough to show the water when sunlit would tend to underexpose the other parts. Photographing distant objects, such as islands, is often difficult, yet it is accomplished as in photo 3 by the clever use of light reflected from water without the use of filters. The light is three-quarter backlighting; that is, the sun is shining toward the camera so that a lens hood must be used. This puts the near side of the islands in shadow. The water becomes a light background upon which the islands stand out in bold relief. Without backlighting the water would have reflected less light, and the islands would have received more light, thus reducing the contrast between them. Note the use of a tree to "frame the picture" and provide an interesting foreground, without which the effect of distance would have been reduced considerably. Contrasts of sunlit portions in dense woods as in photo 4 can be turned to good advantage,



even though there is usually a lack of detail in the shadowed portions. In this picture the reflection of the sun from the brook is dominant, while the sunlight on the slopes beyond serves to increase interest. The snow gives needed contrast.



Three-quarter views of a boat, from either bow or stern, usually produce the most interesting photos of this type, partly because the curved lines of the boat are brought out to advantage



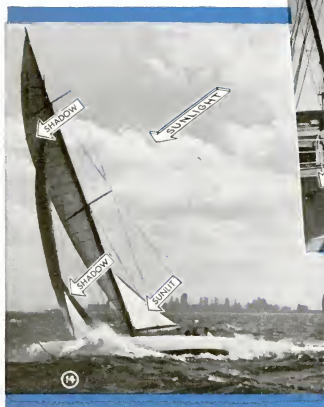
There are countless activities around water that will make good pictures. In photo 5 the lighting was somewhat flat so the photographer framed the scene with objects partly in shadow. A scene around water, which presents one picture in the daytime can often be made to produce an entirely different picture at night. Photos 6 and 7 show the Washington Monument as taken from the steps of the Lincoln Memorial in daylight and at night. If the reflected images in either one of these pictures had been eliminated, the effectiveness would have been lost. In photo 8 a slow, calm river has been pictured in bright sunlight.

In such pictures, shadow detail is difficult to obtain. The shadows occupy a small portion, and they are located as to increase the effect of depth in the picture. Sunlit leaves and areas form the greater portion, and the exposure should not be less than $\frac{1}{25}$ second in order to stop the ripples that give life and texture to the water. Another method of photographing water is shown in photo 9—in this case Old Faithful geyser. Water and steam tend to photograph very light, and would be lost against the sky if the blue light were not reduced or eliminated by using an orange or red filter. In this case the photographer used a light red filter, and waited until a breeze had blown aside the steam and revealed the central column of water.

The Mississippi river towboat, photo 10, makes a valuable record picture. In taking such subjects, however, it is well to avoid using heavy filters which tend to cut down atmosphere because the interest is in the

object, not in the distant scene. A light yellow filter is all that should be used to avoid such division in interest as would occur if the distant shore stood out in full detail. Pleasure boats are interesting subjects. There are good and bad ways of photographing them. Photo 11 illustrates the angle of view that usually brings out the best in any sailboat. A three-quarter stern or bow view is usually best as it emphasizes the length of a boat. Photo 14 was taken from the windward side, but the subject of the picture was a very long and low-sided racing sloop, so long and so low that the resulting heightening of her topsides was not harmful to her appearance. Both pictures show the set of the sails, especially the twist, which makes such pictures extremely attractive. As a general rule, avoid straight side shots. Interesting photos of steamers at docks are also taken in this way, as in photo 13.

Spray spanked into the air by the tail of a fighting fish is a familiar sight, but it is rarely photographed as well as it was in photo 12. The



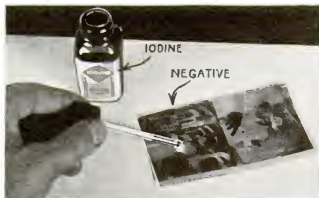
dark background and strong three-quarter backlighting have brightly illuminated the spray, and a carefully calculated exposure has allowed each flying drop to trace its path for a fraction of a second. Note that although the figure is backlit, the underside of the hat is highlighted by reflection from the surface of the water beyond.

Cellophane Coating Gives Photographs Permanent High Gloss Finish

Photographs can be given a permanent high gloss finish by gluing clear Cellophane to them. Dip a sheet of Cellophane in water and squeegee it to a ferrotype tin. Also, soak the print in water for a few

minutes, blot it, and apply an even coat of resin-type glue. The print is squeegeed to the Cellophane on the tin and is placed under a weight for 12 hrs., after which both print and Cellophane are trimmed.

Black Spots Removed From Film With Tincture of Iodine



Black spots on negatives can be removed by scraping them off with a sharp knife, but most amateurs will find this method easier: touch the spot with a tiny bit of tincture of iodine. This will convert the silver of the spot to silver iodide which can be washed off with plain hypo. Be sure to use plain hypo, not acid fixing solution.

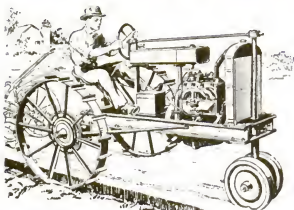
After the spot has been removed, the resultant light portion can be retouched in the usual manner.—Bob Hurst, Chicago.

Safety Strap on Reflex Camera

Buttoned to your vest or coat, this safety strap will keep your reflex camera from swinging out from your body and possibly being damaged by hitting something. The head of an old key is soldered in the screwdriver slot of the bolt which fits in the tripod socket, and the leather tab from an old pair of suspenders is connected to this by means of a key ring.



How to Build a Farm Tractor in Your Spare Time



Having plenty of power to pull a two-bottom plow and other implements, this farm tractor, built from old car parts, includes a Ford model-A motor and twin transmissions giving six speeds forward. Wrenches, hacksaw and drill are about the only tools needed—welding can be done at your local machine shop. Set of three 17 by 22-in. plans, Nos. 1024 to 1026 incl., containing construction details and material list will be sent postpaid upon receipt of 75c.

OTHER BUILD-IT-YOURSELF PLANS

STREAMLINE FAMILY TRAILER—937 to 942: Includes all the conveniences of home with sleeping accommodations for four. Trailer is 15 ft. long and weighs approximately 1,400 lbs. Six prints \$1.50.

UTILITY TRAILERS—986 and 987: Built of old auto parts and lumber. Adaptations of body to suit various purposes. Two prints 50c.

ELECTRIC SPOT WELDER—891 and 892: Works on 110-volt, 60-cycle alternating current. For small work up to 1/8 in. in thickness. Two prints 50c.

ELECTRIC ARC TORCH—106: Carbon electrodes 1/8 in. dia. produce arc for soldering, brazing, light welding. For 110-v. 60-cycle a.c. 25c.

LAWN CHAIR—529: Plain-sawed Southern style. All parts 3/4-in. stock. Easily made with hand tools. 25c.

TRELLIS SUGGESTIONS—639: Shows construction of six different types that will help to beautify your home. One includes corner seat. 25c.

ARTISTIC DOG HOUSES—826: Shows four attractive designs. Also tells how to determine right size house for any dog. 25c.

LAWN CHAIR ON WHEELS—978: Light in weight and easy to wheel to any location. 25c.

DUTCH WINDMILL FOR GARDEN—890: Excellent place to store garden tools. 10 ft. high, 54 in. in diameter at base. 25c.

Order plans by number and title. Send 10c for 128-page catalogue of popular mechanical books and handicraft plans

Address Plan Service, Popular Mechanics Magazine, 200 E. Ontario St., Chicago, Ill.

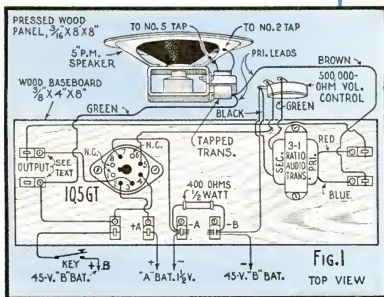
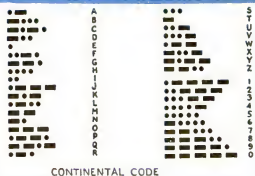
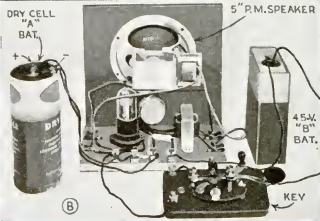
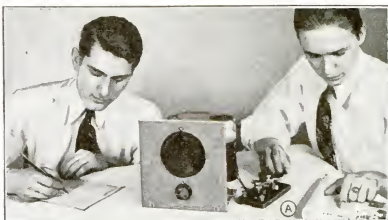


Battery-Operated CODE PRACTICE OSCILLATOR

WITH the increased need for radio communications men in this country's national defense program, many requests are received for information on simple devices for practicing the radio code. Perhaps the simplest possible method would be to connect a key in series with a dry cell and a small buzzer. Although this would answer the purpose, the resulting signal is unstable and ragged as compared with the smooth high-pitched note of a vacuum-tube oscillator.

The code-practice oscillator illustrated requires only a handful of parts, it may be assembled quickly and can be operated in any location as it is powered by two inexpensive batteries. Although headphones may be substituted if desired, the inexpensive permanent-magnet speaker will provide ample volume for group code practice.

All parts are clearly indicated in the simplified wiring diagram Fig. 1. Photos A and B show the completed instrument. The



400-ohm resistor acts as a grid leak; energy from the output of the amplifier is fed back into the input causing it to oscillate at a pleasant tone of about 400 cycles. The input transformer is a 3:1 audio type, and an octal base bread-board type socket is used to mount the 1Q5GT tube. A speaker-matching transformer of the

(Continued to page 180)

Self-Powered

4-PURPOSE

By Stanley Johnson

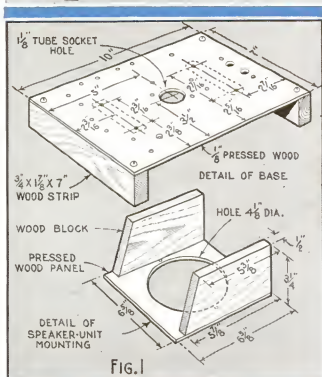
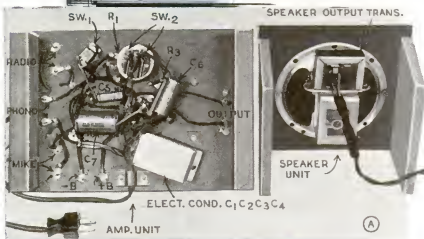


SIMPLE in design and easy to build, this one-tube "4-in-1" audio amplifier has almost as many uses as parts. To begin with, it is a self-powered amplifier which will boost the volume of any good crystal set or a one-tube receiver to loudspeaker output on local stations. It will also give strong headphone volume from the one-tube set on distant stations.

Second, when a single-button carbon microphone is connected to the "mike" input posts it becomes a serviceable low power public address unit and no microphone battery is required. The speaker unit may be connected to long cabled leads between counter room and kitchen in small cafes and sandwich shops, or, between the basement and other rooms in the home.

Third, when connected to a record player with a crystal pickup, the pickup leads being connected to the phono input posts, the unit will reproduce phonograph records with satisfactory volume for the average room.

Fourth, this versatile unit will operate as a B-elimina-



AMPLIFIER UNIT for experimenters

tor to furnish approximately 80 volts to replace B-batteries on a small receiver. When the amplifier serves as a B-eliminator no direct ground must be used on your receiver. Ground the receiver through a .1 mfd. 600-volt paper-type condenser. The unit operates directly off the 110-volt power line and employs a type 117N7-GT combination rectifier and beam-power amplifier tube. The amplifier portion of the tube is rated at 1.2 watts output.

To simplify construction, the amplifier unit is built up on a hard pressed wood baseboard as detailed in Fig. 1. The speaker is mounted on a pressed wood baffle which is supported by means of wood blocks as shown or may be housed in an open-back box if desired. The simplified wiring diagram appears in Fig. 2 and the schematic circuit diagram in Fig. 3. Toggle switch No. 1 is necessary to switch the input transformer (T₁) out of

(Continued to page 182)

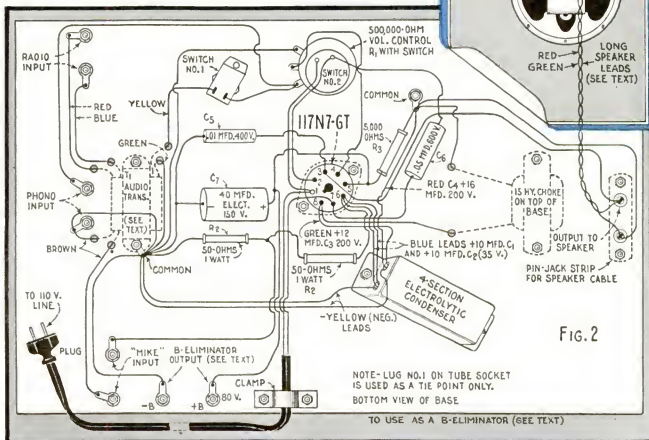
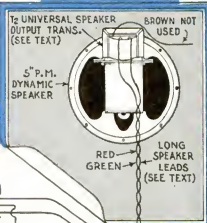
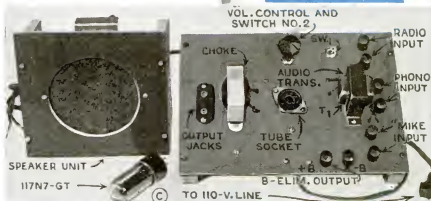


FIG. 2

Seven Crystal Sets For Beginners

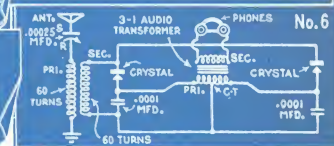
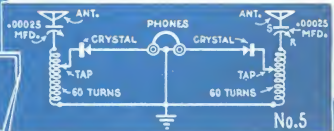
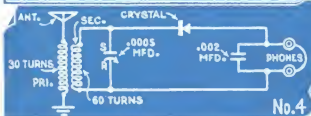
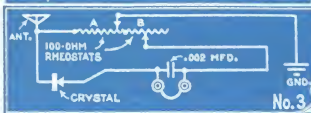
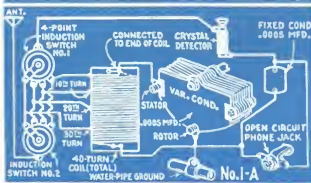
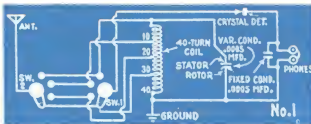


FOR the beginner in radio the crystal receiver has a special appeal. The many possible circuit variations and low cost are some of the reasons for the continued popularity of this simple form of receiving circuit.

No one ever complained about the tone quality of a crystal receiver when used with a good pair of 2,000 ohm headphones. Although distant reception is possible under certain favorable and unusual conditions, crystal receivers of any description are limited to a practical range of about 10 miles for moderately powered broadcasting stations. A good crystal detector is highly important and these vary widely in efficiency.

Figures 1 and 1-A show a popular circuit that offers some degree of selectivity, which most crystal sets lack. It may be housed in a wooden cabinet 10½ in. long, 7¾ in. deep and 7½ in. high as shown in sketch, if desired; or, the builder can assemble the parts on a piece of ½-in. board 10 in. long and 7½ in. wide and use a piece of hard pressed wood for the front panel. The coil is wound on a cardboard tube 4 in. in diameter and 5 in. long, with No. 18 double-cotton-covered magnet wire, or any size of small insulated copper wire available, that will permit winding a close-wound single layer. The .0005 mfd. variable condenser used was taken from an old

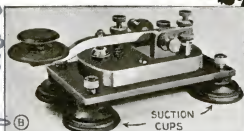
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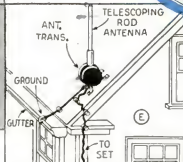
Practical RADIO HINTS

(A) Compact low-cost battery-operated signal generator, for resetting push-buttons in home or auto sets, requires no external antenna or direct connection to the receiver. Self-contained, it covers the standard broadcast band and produces a steady modulated or straight CW signal

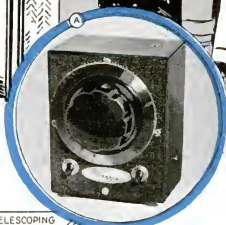
(B) Key mounted on a piece of hard pressed wood, and supported by 4 small suction cups, handy for portable use and emergency work



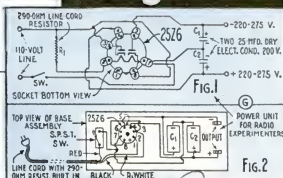
(C) Wet electrolytic condenser in 4, 8 and 16 mfd. 600-volt rating, as compared with 350 and 500 volt ratings heretofore supplied



(E) Improved rod antenna claimed to reduce man-made static on all frequencies. (D) Lettering on metal radio panels with steel-stamp letters. Clamp straight-tied block on panel to line up letters and make impressions before painting. After crackle enamel dries, use a steel erasing shield while removing finish in neat outline around letters



(F) Compact transmitting condenser mounts either on panel or on removable stand-off insulators. (G) Inexpensive spare power unit supplies any small receiver. Caution—use a .1 mfd. 600 v. condenser in series with ground on receiver



Vertrud Inf Co
132 Nassau
New York

Rever Corp. New Bedford, Mass.

Allied Radio Corp
Chicago

National Co. Inc.
61 Sherman
Malden, Mass.

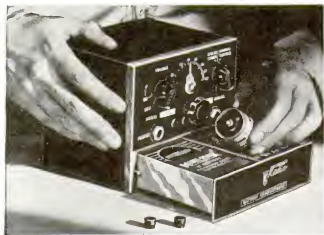
All-Purpose Portable Receiver Has Extra Loop Antenna



Designed to work where ordinary miniature portable sets will not, this tiny receiver employs an extension loop antenna that is easily fastened to a window and plugged into the set for use in trains or cars as illustrated. A built-in loop antenna is employed for receiving under normal conditions. Three-way in operation it may be used either on a.c. or d.c. electric current when available, or from its own self-contained batteries in any location.

Battery Radio for Light Planes

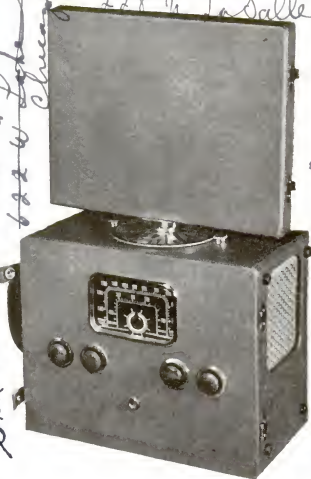
It's like loading a flashlight to change batteries in this compact set which tunes the complete aircraft band covering radio weather, beam and control-tower signals.



A separate switch from control tower to beam eliminates need for changing tuning dial. Batteries plug into contacts inside the drawer; complete set with batteries weighs only 6 pounds.

Navigate by Radio Beacon

Built to meet the needs of yachtsmen, this 6-tube "sailor's" set tells your exact location by use of the radio compass, and



when bad weather hits you can sail into port by radio beacons. Portable and universally powered, it can be taken ashore for use in the car or home. It is equipped for reception on long-wave weather band and standard broadcast.

Blueprints covering simplified radio construction articles in this and past issues are available for 25c each. Many popular tested circuits to choose from. Original detailed parts lists with names of supply sources, can be obtained from Popular Mechanics Radio Department upon receipt of postage.

NEXT MONTH—How to Build a Home Recorder and Player Unit That Works With Your Receiver. Records speech and music from a microphone, or programs "off the air" with any radio; plays recordings back immediately. Has built-in pre-amplifier for crystal microphone; neon bulbs show correct volume setting.

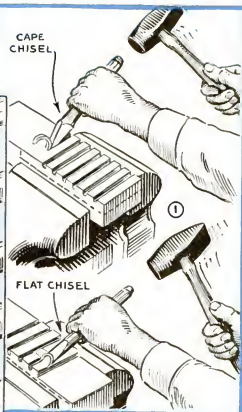
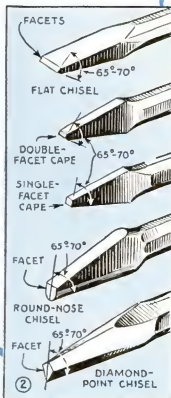


SHOP NOTES

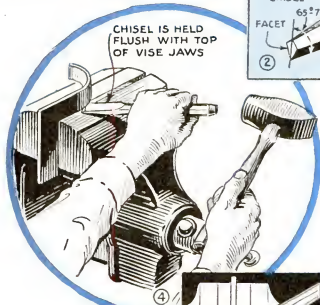
THE TRICKS OF USING COLD CHISELS

By C. A. Crowley

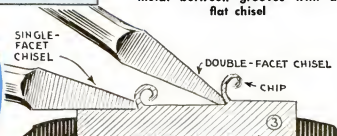
CUTTING bar stock, shearing heavy metal, roughing down large pieces of metal, cutting oil grooves and keyways, and many other operations can be done quickly and accurately with cold chisels, if a few simple rules are observed in using them. Cold chisels are bars of steel, tempered and sharpened at one end, and of such size that they can be driven with a hammer for removing or cutting metal. The flat chisel, double and



To remove a large section of metal, first chip a number of grooves with a cape chisel, then remove metal between grooves with a flat chisel



Heavy sheet metal is sheared by clamping it in a vise so line to be cut is flush with the jaws, and using a flat chisel held at an angle to the work



single-facet cape chisels, round-nose and diamond-point chisels illustrated in Fig. 2 are the five main types. While there are variations of each of these designed for special purposes, these five styles usually are sufficient for most jobs.

Whether it is divided between one or two facets, the cutting angle should be kept about 65° or 70° for average work, as shown in Fig. 2. The edge of the flat chisel should not be more than 3/4 in. wide be-



cause on iron and steel this will take all the driving power that can be applied with the usual shop hammer. When a heavy chip is to be removed, such as in cutting a keyway, a cape chisel is used. Round-nose chisels can be used for cutting oil grooves, filleting corners, etc. The diamond-point chisel is useful in trimming out sharp corners. To chip, or remove surplus metal from a broad, flat piece, chip grooves in the work with a cape chisel and remove the material between the grooves with a flat chisel, as shown in Fig. 1. The grooves should be spaced slightly closer together than the width of the flat chisel. The work is placed in the vise at about elbow height, and in such a manner that the blows are struck at right angles to the jaws to prevent the work from slipping. The chisel is held firmly enough to guide it, but still loosely enough to prevent the shock of the hammer blow from imparting a sting to the hand through the chisel. As illustrated in Fig. 3, chisels should be held so that the lower facet or surface lies flat on the work. Too steep an angle will tear and gouge the metal. It helps to keep the eyes focused on the cut rather than the head of the chisel. When working with metals other than cast iron, chisels should be lubricated every few blows. Any good grade of cutting oil will be found satisfactory.

Heavy sheet metal can be trimmed or sheared to shape quickly as shown in Fig. 4. The line along which the cut is to be made is placed flush with the jaws of the

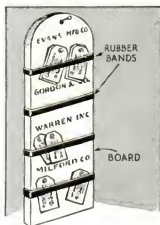
vise. A flat chisel is used, the edge being held at an angle to the work to produce a shearing action. Holes in sheet metal can also be cut with cold chisels. The metal stock is placed on a flat surface and a narrow chisel is applied so that the cut conforms closely to the guide line. When trimming off large projections, such as bolt or rivet heads, a cape chisel is used. Always make the first cut down from the center, and then chip off the rest. This method will remove them easily and avoid damaging the surface of the work.

In cutting oil grooves or keyways, chip both ways toward the center of the desired keyway or groove to prevent the ends from breaking out. Swaging, as illustrated in Figs. 5 and 6, is best done with a flat or cape chisel. This procedure is useful for fastening together small assembled parts where the pieces fit closely and need only a little upsetting of the metal to keep them from slipping apart. With a little care, hand knurling on small cylindrical pieces can be done. Place the work in a V-block and use a sharp flat chisel, making grooves around the work parallel to its length. If it is not too deep, a drill hole that has wandered off center can often be chipped back to center with a round nose chisel.

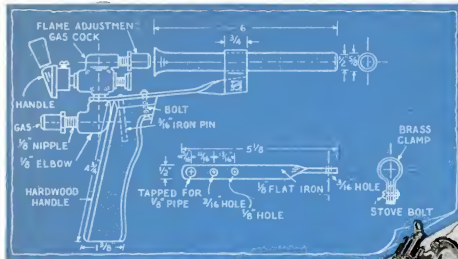
In order to do good work, chisels must be kept sharp. Some of the newer chisels on the market are made of alloys which are tough enough to stand hard use but still are soft enough to be filed sharp. Better results are obtained, however, by grinding chisels to sharpen them.

Portable File for Shipping Tags

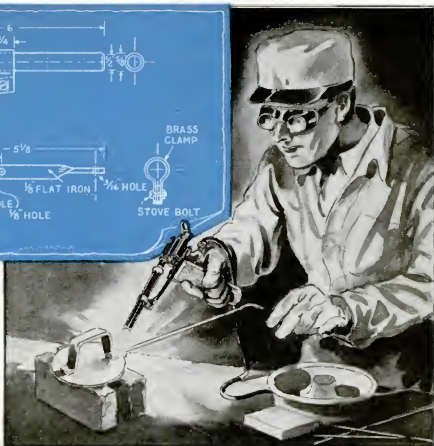
To keep prepared tags separated and ready for use, one clerk uses a board to hold them as shown. Several stout rubber bands are snapped around the board to hold the various tags in their designated places.



Gas Torch Works Without Compressed Air



Using ordinary illuminating gas, this torch, which anyone can make, is ideal for silver-soldering, light brazing and building up of small brass parts. It consists mainly of a gas cock taken from an old stove, which is fitted with a handle and a flame tube as indicated. The shape of the tube is important. It should be flared at the rear end and the front end should be rounded over slightly to concentrate the flame. In use,



the flame-adjustment nipple shown in the detail, should be set at the point where the flame produces the loudest noise.

—Walter E. Kenzel, Bronx, N. Y.

Harness Sets Hung in Barn on Novel Hook Assemblies

Polished cow horns were used by one farmer as novel hooks on which to hang harness in his barn. Holes cut in a 2 by 6-in. plank take the butt ends of the horns, which are secured in place by long bolts run through both the horns and the plank. Another farmer found that old auto connecting rods were ideal for the same purpose. After removing the bearing caps, the rods were bolted to a crosspiece.



Cleaning Roller on Tape Machine

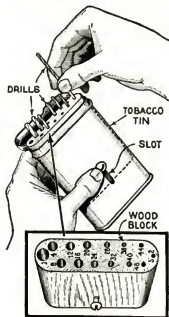
Rollers on gummed-tape machines sometimes become coated with a silicate-of-soda solution which is used as an adhesive on the tape. This then forms a glass-smooth surface on the roller and prevents the tape from taking up water. By dissolving the soda on the roller and roughening it slightly with a wire buffing wheel, an improvement will be noticed and tape that seemed useless will be satisfactory.

Holding Printing-Press Grippers Out of the Way for Wash-Up



If you have ever bruised or scuffed your knuckles against the grippers of a printing press when washing the rollers, you will appreciate this clamp. Made from heavy galvanized sheet iron, it is used by first pulling the grippers down against the tympan sheet and then slipping the clamp over one of the grippers and under the sheet as indicated. This holds the gripper entirely out of the way.

Drill Case From Tobacco Can



When working on a job where it is necessary to carry several drills, this case or holder, which fits nicely in your pocket, will enable you to select the desired drill at a glance. The case consists of a block of wood shaped to fit inside of an empty tobacco can. Holes are drilled in the block and

the drill sizes are printed next to them. A slot in the side of the can takes a screw which is driven into the block and projects

to raise the block to the top of the can so a drill can be withdrawn easily.

—Wm. B. Ramsey, Atlanta, Ga.

Paint in Partly Filled Container Protected With Gas

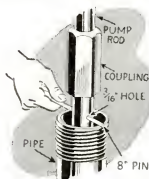
In one shop where large containers of paint were only partly used on a job and then were set aside for a few days, skin was kept from forming on it by filling the container with regular illuminating gas. The gas displaced the air inside the can which caused the skin to form. To get the gas in the container, cocks were installed in the lid as shown. In use, both cocks are opened after pressing the lid tightly in place. This lets the gas enter the container and replace the air, after which both cocks are closed.

—Linus M. Webb, Syracuse, N. Y.



Pin Holds the Pump Rod in Place While Dismantling Well Pipe

Having several pumps which had to be removed from wells at various times to

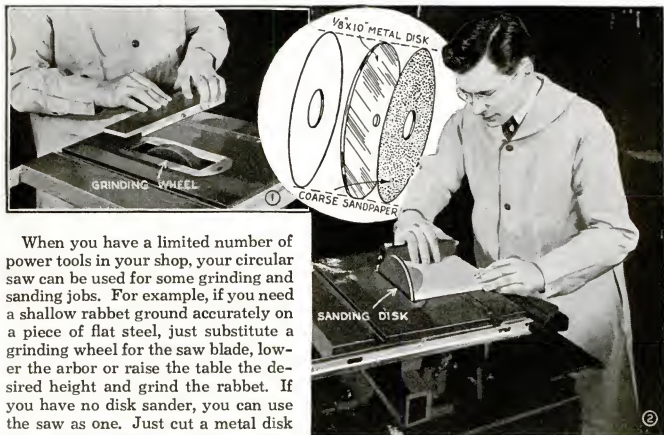


repair the cylinders, we were able to save considerable time by using pins to hold the pump rods in place while disconnecting them. Holes were drilled through the rod just below the

couplings at all of the joints. Then as the well pipe was raised and disconnected, a pin was slipped through the hole in the pump rod to keep it from dropping down into the pipe while unscrewing the rod coupling and raising the well pipe to the next joint.—Ernest Hahl, Shandon, Calif.

Large staples driven in the edge of a drawing board will hold pens and brushes in an upright position when not in use.

Circular Saw Serves As Grinder and Sander



When you have a limited number of power tools in your shop, your circular saw can be used for some grinding and sanding jobs. For example, if you need a shallow rabbet ground accurately on a piece of flat steel, just substitute a grinding wheel for the saw blade, lower the arbor or raise the table the desired height and grind the rabbet. If you have no disk sander, you can use the saw as one. Just cut a metal disk to the required size and drill the center to fit over the saw arbor. Then cement fine sandpaper on one side and coarse on the other. This gives you a sander with a

machined table and a miter gauge for sanding the edges of work at an angle or so they are square.

Wood Carvers' Clamp Allows Work to Be Turned At Will

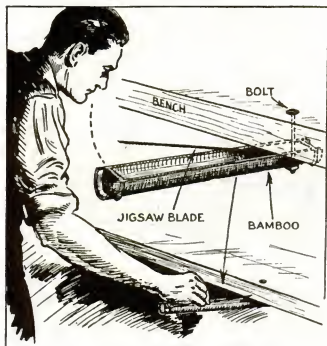
On certain woodworking jobs where the position of the work must be changed frequently, such as in carving, this clamp will be a timesaver. It consists of an iron rod threaded its entire length and fitted with a T-handle at one end. The other end is drilled to take a headless wood screw. A "wingnut" made from a piece of flat iron screws onto the threaded rod. In use, a piece of waste stock is drilled at the outer end to take the rod, after which it is clamped to a bench or table. Then the work to be carved is laid over this drilled hole and the wood screw is inserted through the hole and turned into the work. Next the nut is run up against the waste stock, after which the tightening is completed by turning the handle.

—S. J. Gancher, Richmond Hill, N. Y.

❶ In many cases, a file can be cleaned quickly with adhesive tape. The tape is merely pressed firmly on the file tacky side down, and then stripped off, repeating the operation with clean tape if necessary.

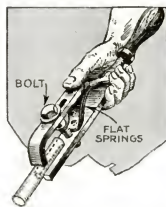


Bamboo Pivoted to Bench Top Stores Jigsaw Blades



Cut from the butt end of a bamboo fishing pole, this curved drawer for jigsaw blades can be pivoted under the edge of your workbench. To remove a blade, just swing the drawer out.

Quick-Acting Tool Grips Work While Tempering With Torch



This simple tool will be found a timesaver for holding small parts while tempering them with a torch or in a small forge. It is made from flat steel, and the jaws are operated by pressure of the thumb to pick up or release a piece of work.—Chas. H. Willey, Penacook, N. H.

Chucks of Drills and Braces Shielded to Keep Out Dirt

Dirt cannot enter the chuck of a drill or brace carried in a tool box if a simple shield like the one shown is used to protect it. The shield is



nothing more than a cork of suitable size hollowed out as shown so it will slip over the chuck jaws. A nail run through the cork is gripped by the chuck jaws to hold the shield in place.

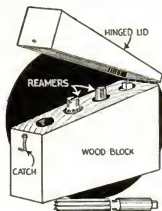
Typist's Copy Holder From Book

To hold manuscripts while typing, assemble this holder from a notebook and a spring clip. Just stand the notebook up and attach the manuscript to it with a clip.



Wood Case for Your Reamers

The cutting edges of reamers will be protected in this holder and they can be removed easily. It consists of a wood block sawed off at an angle near one edge as indicated.

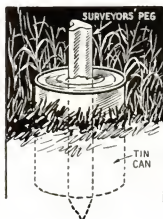


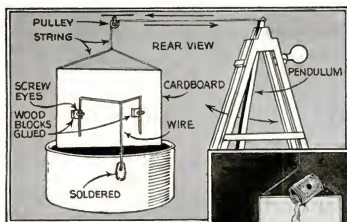
Holes are then drilled in the block to take the reamers, which project slightly. A lid of thin wood is hinged to the block. If desired,

the portion of the block that was sawed off can be used as a lid if holes are drilled in it to take the projecting ends of the reamers.—Truman Greenwalt, Litchfield, Ill.

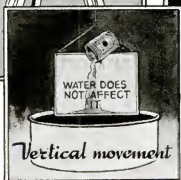
Position of Survey Pegs Marked By Tin Cans

Difficulty in locating survey marking pegs on vacant lots caused one real estate dealer to drop inverted tin cans over them. The cans kept down the growth of weeds or grass and made the pegs easy to find.





By running a cord over a pulley you get vertical movement, while a simple connecting rod gives horizontal movement



For swinging movement, you can attach a moving hand to the tip of the pendulum. Or, you can substitute something else like the head of a figure or a disk that appears to roll

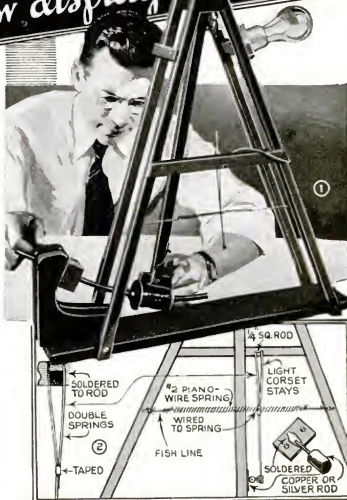


SOLENOID PENDULUM

operates window displays

AS A novel window display by itself, or as a means to actuate other display devices, a solenoid pendulum, Fig. 1, is something anyone can build. This one operates on 110-volt current, either a.c. or d.c. It is really a swinging motor which gives rise to considerable guessing on the part of spectators as to what makes it work. By using various sizes of lamps to control the current passed through the solenoid, the power of the impulses can be governed. For fast strokes a short pendulum is used but for slow and easy motion a long pendulum is best. Three types of window display movements are shown at the top of this page. In most cases where the solenoid itself is not the display, it and the connecting parts to the display can be concealed.

A word as to how the thing works: a coil of wire through which an electric current passes has a magnetic field



and prevents breakage of parts if the pendulum swings too far. The contacts should be silver although copper will work. The spring arm, which holds one contact, is held by a coil spring which permits necessary flexibility. The position of the contacts for correct timing must be accurate to get an impulse of maximum strength. To make the adjustment, slip the arm between the coils of the spring. Then, after wiring according to Fig. 3, the current is turned on and the arm is moved back and forth on the spring until the critical point is found, after which the arm is securely tied to the spring in this position. You will note from one of the details how the silver contact is located on one side of the arm and the nonconductive contact on the other. The power take-off is from the tip of the pendulum and the pull is quite strong owing to the leverage of the pendulum.

Adjustable Hanger for Inspecting Garments in Cleaning Shop



To hold dresses and other light garments suspended at various heights over his bench for repairs and inspection, one dry cleaner uses a window-shade roller and a length of cord. The roller is attached to a wall. The cord passes through a screw eye in the ceiling and is then wrapped around the roller, the other end being tied to a ring in which the hanger is hooked.

JULY, 1941

Mechanic Makes Sidewalk Sign From Old Lawn Mowers



One mechanic who sharpened lawn mowers made a sidewalk sign appropriate for his business from parts of old mowers. Two handles provided the supports, and an old cutting reel or blade served as a cross member at the top. The lower ends of the handles were bent at right angles and were screwed to bases. Rectangular pieces of sheet metal nailed between the handles carried the advertising message.

—Irving Salzer, Baldwin, L. I.

Depth Gauge on Disk Harrow To Prevent Cutting Roots

In order to set his disk harrow so that it would turn the soil sufficiently to do a good job of tilling, yet not penetrate the ground far enough to injure tree and vine roots, one farmer fitted it with depth gauges. These consisted of strips of old automobile tire wound around the harrow axles as shown in the photograph. The tire strips were held in place by clamps made from barrel hoops.

—Joe Martin, Paw Paw, Mich.



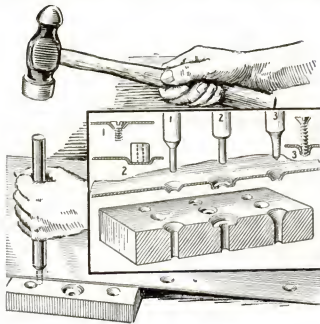
Comb of Safety Razor on Level Scrapes Top of Form



In checking concrete forms with a level, one workman employs a safety-razor comb on the end of his level to scrape off dried concrete from the form board to assure accuracy of the reading. The scraper is always at hand when it is needed, and does not interfere in any way with the regular use of the level.

Inexpensive Punch-and-Die Set For the Sheet-Metal Worker

Workmen in a small sheet-metal shop where tools are necessarily limited, will find this punch set handy. It consists of three punches and a steel block having



three rows of holes in it, each row consisting of three holes of different diameters. The first row is for making countersunk holes in sheet metal, and the second row is for making vent holes, or holes that are to be plugged, while the third row is for piercing the metal to give a couple of extra threads when sheet-metal screws are used, or when the holes are to be tapped for machine screws.

—Michael F. Wolf, Minneapolis, Minn.

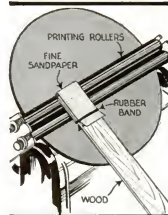
Test Samples of Sacked Grain Taken With Oilcan Spout

One merchant who purchased grain from local producers and found it necessary to take samples from each sack for testing, removed the samples without opening the sacks. This was done with an oilcan spout having a hole cut in one side near the center. When the spout was pushed through the sack, enough grain for a test ran into the hole of the spout, which was then withdrawn.



Sandpaper Removes Bits of Ink From Rollers of Printing Press

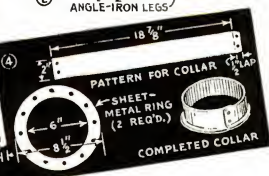
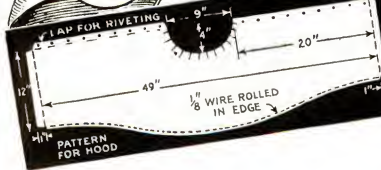
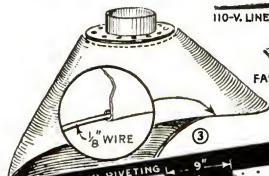
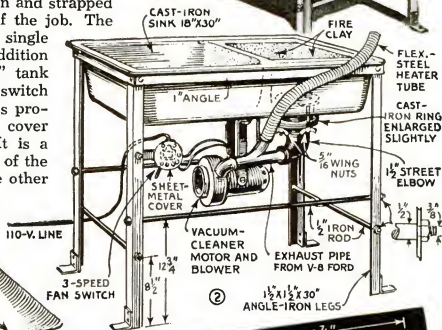
Instead of risking damage to the rollers of a printing press by using a knife or spatula to remove bits of ink or pieces of paper, fold a strip of fine sandpaper over the end of a piece of flat wood and fasten it in place with a rubber band. Then use it as shown in the drawing. The rough surface of the paper will pick up the smallest bits without injury to the roller and may even be used when the press is in motion.



SHOP FORGE

has electric blower

ASSEMBLED entirely from discarded materials, this forge consists essentially of an old vacuum-cleaner motor and blower, and a cast-iron sink. The dimensions given may be altered to suit the material at hand. The air blast from the blower is divided, half of the air being diverted up the stack to keep the shop clear of smoke, the Y-fitting for this purpose having been taken from a Ford V-8 exhaust pipe. The original strainer in the sink serves as the tuyere iron, and a 1½-in. street elbow connects the sink with the draft pipe. The cast iron ring that originally held the lead pipe to the sink outlet can be used to hold the street elbow if it is enlarged slightly. By using wingnuts on the bolts, it is an easy matter to remove the elbow for cleaning out ashes and cinders. A piece of flexible tubing run up the hood from the Y-connection and strapped to it completes this part of the job. The hood itself is made from a single piece of sheet metal. The addition of brackets and a "douse" tank completes the forge. The switch for controlling the motor is protected with a sheet-metal cover and gives three speeds. It is a good idea to line the inside of the sink with fire clay or some other refractory material.



Tabs around the smoke opening of the hood are drilled for screws to attach a ring and collar assembly, which takes a smokepipe

Simple Beam Compass to Scribe Extra Large Circles

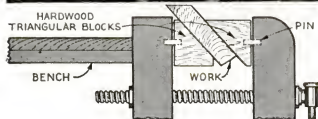


Needing a beam compass for laying out boat frames, I made a couple of fittings so that a steel tape could be used for the purpose. The fittings are made of steel, and can be adjusted quickly to scribe accurately a circle of almost any desired radius.

—George A. Wilkinson, Mystic, Conn.

Shaped Blocks Hold Work in Vise While Planing Edge at Angle

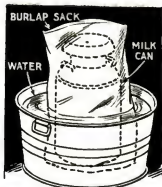
When the edge of a board or block must be planed at an angle, a couple of triangular blocks to fit between the jaws of your vise and grip the work at the desired angle



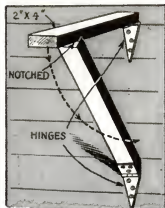
will facilitate the work. A couple of dowel pins in each vise jaw to fit in holes in the blocks will hold them in place while opening or closing the vise.

Milk Cans Set Along the Roadside Cooled by Evaporating Water

Cans of milk or cream left at a roadside for collection by a dairy truck, can be kept cool by setting the cans in tubs of water and slipping wet burlap sacks over them. The sacks act as wicks in the water, which is evaporated from the burlap to cool the cans.



Folding Brackets for Heavy Work



Here is a handy bracket for use in driveways, barns or implement sheds where it is necessary to provide temporary storage of heavy objects off the floor. The brackets are made of 2 by 4-in. stock, and consist of two

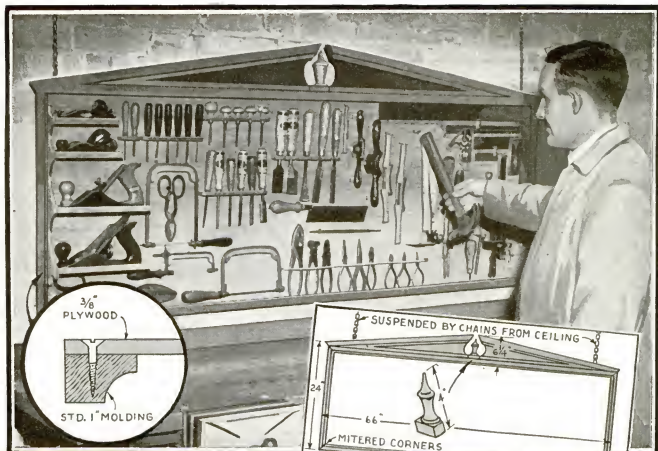
parts, which are fastened to the walls with heavy hinges, as indicated.

'Ear' Keeps Washer From Turning

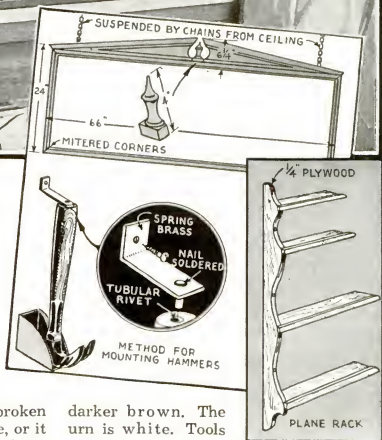
On certain types of machinery where slow-speed chain or belt idlers are held in place on stub shafts with flat washers and cotter pins, the washer can be prevented from turning with the idler and wearing the cotter pin by simply forming an ear on the washer and bending it outward as indicated. In this position the ear rests against the cotter key.



Tool-Mounting Board With a Colonial Touch



The home owner who has his home built or furnished in Colonial style can even continue the same touch right into his workshop by building this tool-mounting board. It is simply a panel of $\frac{3}{8}$ -in. plywood, or rigid composition board of the same thickness. The molding is standard and can be purchased for a few cents per foot from any lumber dealer. It is attached with small wood screws driven through from the back. The urn, centered in a typical "broken arch," can be whittled from soft pine, or it can be made as a split turning if a lathe is at hand. For finishing, the panel was given two coats of boiled linseed oil, the moldings were enameled a medium brown and the areas flanking the urn were enameled a



darker brown. The urn is white. Tools can be mounted by groups. Marking and measuring devices, hammers, edge tools, etc., were placed together. The small sketch also shows a novel way of mounting wooden-handled tools.

Rubber Cement on Draftsman's Drawing Board Holds Paper Securely

Instead of using thumbtacks for holding the drawing paper in place on the boards, draftsmen in one large office cover the boards with rubber cement. It is thinned somewhat before applying to allow smooth spreading. When dry, it is just tacky

enough to hold the paper firmly in place, and much time is saved due to not having to insert tacks before going to work on a drafting job. Besides, when erasing, the paper is held firmly over its entire surface and there is no tendency to pull away.

Metal Trough at End of Counter Aids in Dispensing Screen Wire



Hardware merchants and others who sell screen wire will find that a trough at the end of a counter enables them to measure off screen wire with ease. The trough consists of a length of stovepipe, cut along one side as indicated. In use, the roll of wire is laid in the trough, after which the required length of wire can be unrolled on the counter, the trough keeping the roll in place.—Richard K. Wahler, Waupun, Wis.

Combination Drill and Auger Bit To Counterbore Holes



When working on a job where a number of screws are to be driven into counterbored holes and plugged, a combination drill and auger bit of the type shown will save you considerable time. With this tool, the pilot hole for the screw can be

drilled and counterbored at the same time. The tool consists of an auger bit of the proper size which has the screw point filed off and a hole drilled into the end to take a small drill bit. The bit of course, is bro-

ken off so that it projects from the auger end a distance equal to the desired depth of screw holes to be drilled.

—Paul G. Lackey, Washington, D. C.

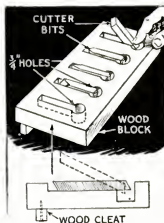
Multiple Shoe Scraper for Use At Public-Building Entrances

Placed at the entrance of a school building, hall or club where several people arrive at the same time, a couple of these scrapers will enable them to clean their shoes without waiting.

They are especially suitable at school-houses as they do not have exposed sharp edges on which children are likely to fall and injure themselves.



Handy Rack Stores Lathe Bits

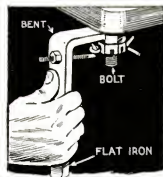


In addition to providing an orderly place to keep lathe cutter bits, this rack has a handy arrangement for removal of the bits. It is made from a single block of wood, which is slotted and drilled as indicated so that

merely pressing on the end of a bit raises it for quick removal. A cleat may be nailed on the bottom to raise the back edge of the rack, if desired.

You Can Get Plenty of Leverage With This Cotter-Key Puller

Difficult cotter keys can be removed easily with this puller. It is made of flat iron, bent as indicated and fitted with a bolt having a hook on one end to slip in the eye of a key.

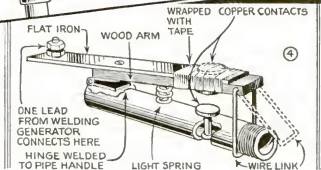
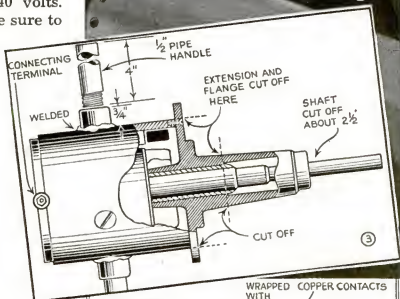
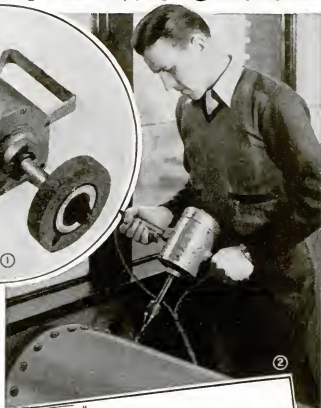
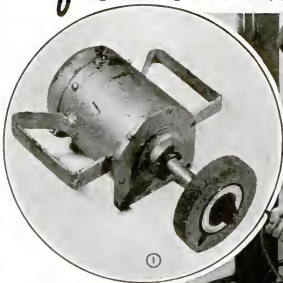


WELDER'S DRILL *and* GRINDER *from old auto starter*

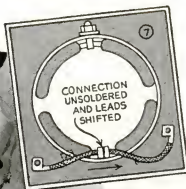
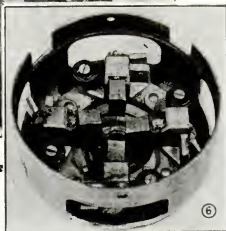
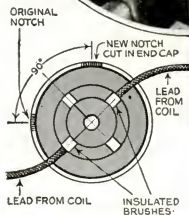
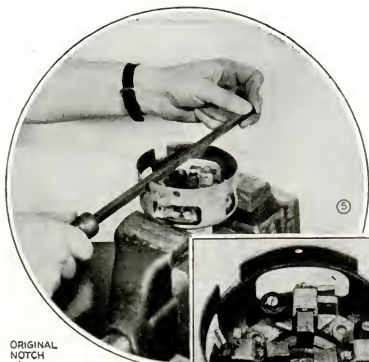
By F. Gage

OPERATING on current produced by a welding generator, this grinder and drill, Figs. 1 and 2, will be helpful to owners of motor-driven electric welding outfits who take them to farm fields and other places where electric current is unavailable. The only expenditure is the cost of a drill chuck, a grinding wheel and a couple of old auto starters. The drill and grinder shown here were made from model-T Ford starting motors, which are rugged and do not burn out easily. They can be operated safely on any d.c. welding generator having an open voltage range from 0 to 40 volts. When using the drill or grinder, be sure to run the generator at idling speed of the motor that drives it so that voltage delivered will be low. A little experimenting will enable you to determine at what speed the generator is producing the voltage most suitable to operate the tools.

After obtaining the starting motor, take it apart and clean it thoroughly, washing the parts with gasoline if necessary. Then inspect the bearings, and replace them if they are worn. If desired, you can substitute ball bearings for the bronze ones already in the motor. Also, check the brushes and replace them if they are worn down. If the commutator is worn, turn it down in a lathe, and undercut the mica, or else replace the armature with one on which the commutator is in good condition. Now, before reassembling the motor, cut off the end plate and armature shaft as indicated in Fig. 3. Be sure that the armature shaft is straight and true. Then thread the end of the shaft to take a drill chuck. As these motors rotate in the opposite direction of a drill, they must be reversed. This is done as in Figs. 5 to 8



inclusive. The end cover is given one quarter turn to the left as you face the closed end of the cover. In this way, the cover is turned so that the screw holes are moved to line up with the next holes in the housing. This makes it necessary to cut a



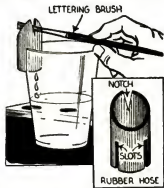
new notch in the cover to straddle the terminal that projects from the housing. You can do this easily with a file or hacksaw. After the cover has been shifted, you will find that one of the coil lead wires is too short to connect to its brush bracket. You can lengthen it with a short piece of wire, of course, but a neater and better way to do the job is to unsolder the leads where they are connected to the field coils, and shift them as shown in Figs. 7 and 8, until both will reach the two insulated brush

brackets to which they were connected, and then resolder them. In examining the brush brackets, you will notice that two of them are insulated with fiber strips from the copper ring on which they are mounted. The leads are connected to these brackets. Before replacing the cover, drill a small hole in the end so that the bearing can be lubricated frequently. A little felt placed inside the cap in front of the hole will help distribute oil to the bearing. This completes changes in the motor.

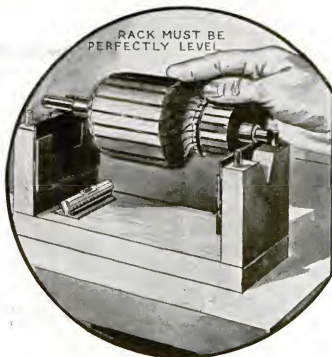
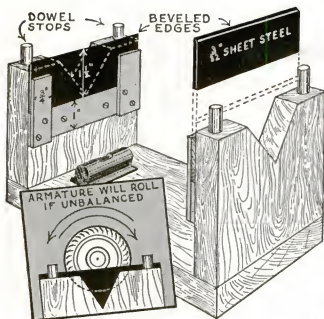
Next, comes a pair of handles. These are pipe nipples, which are screwed into sockets arc welded to opposite sides of the motor housing. The original sockets were made by sawing a pipe coupling in half. Be very careful in doing this welding job to see that the motor housing is not heated enough to damage the insulation of the coil wires inside. One of the handles is fitted with a switch made as in Fig. 4, using heavy copper contacts. This gives instant control of the drill as the switch really becomes part of the handle and must be gripped to keep it closed. If the motor is to be used as a grinder, the treatment is the same except that the armature shaft is threaded for nuts to clamp on a grinding wheel, and the handles are shaped from flat iron to provide grips suitable for manipulating a grinder.

Rubber-Hose Wiper for Art Brush

To clean lettering brushes quickly and, at the same time, draw them to the desired chisel point, one sign writer uses a short piece of rubber hose. This is cut at an angle at one end and notched to shape the brush, while the other end is slotted to slip over the edge of the water glass.



Ways on Rack to Balance Repaired Armature



After repairing an armature, it should be tested for balance to eliminate vibration. To test the armature, you can use a pair of removable, knife-edge ways on the repair rack. For auto armatures and those usually found in the average shop, ways formed from $\frac{3}{16}$ -in. sheet steel will do. You will require one piece for a knife edge, one piece for a horizontal guide and

two pieces for vertical guides at each end of the rack. Mount the horizontal guides carefully, being sure that their top edges are exactly horizontal with the base. Short dowels sunk into the corners of the rack will prevent the armature from rolling off the ways. A small level mounted across the base of the rack will show when it is set on the bench top in a level position.

Simple Method of Checking Wear in Motorcycle Chain

If you want to determine the amount of wear in a motorcycle or bicycle drive chain, a fairly accurate job can be done by using a board set at an incline as shown. Cleats are nailed along one side and across one end. The chain is laid on the board so that it rests against the side cleat with the end against the bottom one. The end position of the chain is marked on the board. Then the chain is pulled up to take up all of the slack, and the end position marked on the board again. The distance between the two marks is equal to the amount of wear in the chain.

—Ivan J. Streeten, Detroit, Mich.

It's best not to follow too closely behind a truck having dual rear wheels because a stone or other object may have become wedged between the tires and will be thrown out by centrifugal force, damaging your radiator, or breaking a headlamp or the windshield.



Sandbag Protects Tire From Heat While Welding Fender



One mechanic who frequently had small breaks in fenders to weld used a sandbag like the one shown to protect the tire from heat of the torch. This saved time as it was unnecessary to remove the wheel to do a couple of minutes work on the fender. The bag was made of heavy canvas sewed to form a number of pockets as shown in the detail.

—G. Rickard, Frederickton, N. B., Can.

Tool Removes Cotter Keys Easily In Places Hard to Reach



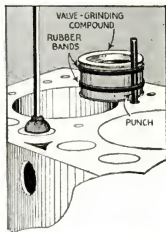
Auto mechanics will find this cotter-key remover a time saver, especially when working on jobs where restricted space causes as much time to be consumed in removing the cotter key with ordinary tools as it takes to make the repair or adjustment. The tool is made from a length of small rod, which is tapered at one end and bent to form a hook. A 4-in. length of steel shafting is drilled lengthwise to slide on the rod and

serve as a hammer in pulling the key. A large washer peened on the end of the puller serves as a striking surface for the hammer.

—Wm. C. Acker, San Francisco, Calif.

Valve-Grinding Compound Kept Close on Motor Block

When grinding valves of a motor, one mechanic keeps the valve-grinding compound close at hand on the motor block by using a couple of rubber bands. The punch is inserted into one of the water openings and the grinding compound can be fastened to it with the rubber bands as shown.

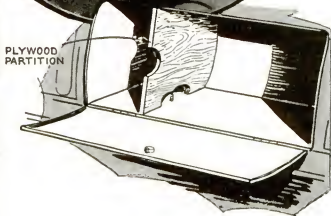
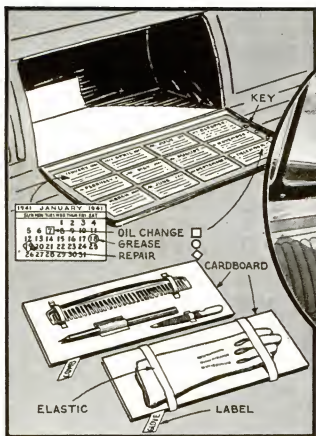


Linoleum on Floor of Car Trunk To Slide Luggage in Easily

Salesmen and others who have to remove luggage cases from the trunks of their cars several times daily will find that heavy cases can be moved in the trunk easily if the floor is covered with linoleum. This is cemented in place, and if kept well waxed, will provide a slick surface on which to slide heavy cases.



Getting the Most From a Glove Compartment

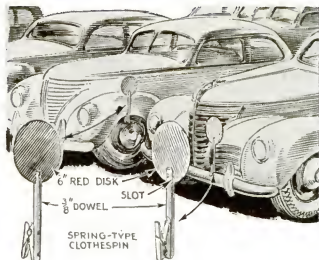


It's a simple matter to convert a glove compartment from the usual catchall to provide maximum storage space suitable to your particular needs. For example, the inner surface of the door can be put to good use by mounting small calendar sheets on it to serve as memo for lubrication and repair data. Or, you can mount pieces of cardboard having elastic bands attached to them, on the door for storing gloves. By using small clips on the cardboard, you can provide a convenient storage space for a comb, pencil, nail file, etc.

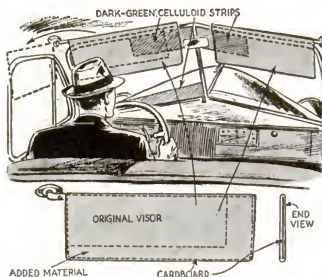
Another idea is to partition the compartment to hold paper napkins, handkerchiefs, etc. And, you can make the partition suitable to file literature or correspondence used in your daily business.

Red Signals on Bumpers Aid Worker in Parking Lot

To distinguish between cars that were to be parked for long and short periods and as an aid in locating the cars in a parking lot, one worker made up a number of red signals that could be slipped over bumpers of the cars. Cars that were to remain in the lot for several hours each carried one of the signals. Thus any worker in the lot knew these cars and parked them at the rear of the lines of cars, leaving the space at the fronts of the lines for cars that were only to remain for a short time. A spring-type clothespin screwed to the signal standard permits clamping it to a bumper.



Glare Shields Protect Your Eyes On Bright Days



Here are a few ideas that will help eliminate glare that tires the eyes on bright sunny days. A strip of colored celluloid along the lower edge of the windshield will keep glare from the car hood out of the eyes. Also, a strip of celluloid placed between the sun visors as indicated will prevent glare from the sun from entering at this point. If you are one of the motorists

that finds your visor either too narrow or too short, a sleeve like the one shown in the lower detail will help. The sleeve consists of thin cardboard folded and sewed to slip over the visor. It is covered with cloth to match the interior of your car.

Wedge Aids in Removing Tire From Large Truck Rim

The next time you have a heavy truck tire that seems almost impossible to loosen from the rim, try using a wooden wedge. Place the rim and tire on a large wooden block or other suitable support that is small enough to permit the tire to slip down over it. Then drive the wedge between the bead of the tire and the rim as shown. This will loosen the tire and stretch it slightly so that it can be forced over the rim flange without damaging it in any way.



—Thomas L. Mino, Cincinnati, Ohio.

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And in this vast field of mobile horsepower, Fluid Drive has revolutionized all previous conceptions of harnessing internal combustion engines. This new development of a time-tested basic principle provides smooth, vibrationless power transmission.

An Aid To Defense

New applications of Fluid Drive are expanding its usefulness. It is indispensable wherever the flow of power calls for flexibility, instantaneous absorption of terrific impulses, peak engine torque and an absence of vibration. Where split-second timing is demanded, the Fluid Drive principle answers a vital need. A tiny

Fluid Drive unit controls the speed of airplane superchargers—giving motors a regulated air supply at high altitudes and preventing disastrous vibration.

In submarines, Fluid Drive permits multiple Diesel Engine hook-ups—cushions volcanic power explosions—even disconnects the engines from propellers in three seconds—a necessity when submerging. Power-shovels now use it to absorb the shock of impact and prevent engine stall. It is solving countless other industrial and utility power problems.

Exclusive of automobiles, the Fluid Drive principle transmits over four million horsepower throughout the world today—energy equal to the combined installed capacity of Boulder and Coulee Dams. Already, Fluid Drive is transmitting well over thirty million horsepower in the motor cars produced by Chrysler Corporation.

A Basic Principle

Fluid Drive has taken its place as a basic principle of power transmission—along with the lever, the inclined plane, steam, electricity and hydraulics. Its principle is an established law of physics—kinetic energy—which is force through motion. Engine power is transmitted through spinning oil. There is no metal to metal contact between motor and drive shaft.

For 25 years, automotive engineers have sought a means of providing acceleration without the bother of gear shifting—to cushion ever-increasing horsepower with the smoothness of steam and the quiet of electricity. Fluid Drive is the final key to this accomplishment. After years of research by Chrysler Corporation engineers, Fluid Drive was introduced in 1938 on the Chrysler Custom Imperials—it since has been made available on all 1941 Dodge, De Soto and Chrysler models.

A new ease of car control—of distinct advantage under present-day traffic

conditions—is provided by Fluid Drive. The motorist can stop, start again, speed up, slow down—drive all day without the continual effort of gear-shifting. Acceleration is smooth, vibrationless!

A Major Achievement

Fluid Drive adds new safety. The danger of engine stall is practically eliminated! On slippery, icy pavements Fluid Drive gives the car a more sure-footed action. Traction is obtained by the cushioned flow of power to rear wheels. Yet, with all these important advantages the motorist has nothing new to learn about driving.

Over 300,000 owners of Dodge, DeSoto and Chrysler cars are enjoying the benefits of Fluid Drive. Like Hydraulic Brakes and Floating Power—two other Chrysler Corporation achievements—Fluid Drive is a major, permanent contribution to motoring comfort and safety. It creates a new high standard of automobile performance and value. It is truly a modern miracle of motor power transmission!

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Just Relax

(Continued from page 95)

who is shot from a cannon lands in his net. None of them hits spread-eagled. Each lands with a roll. Even a person hurled from a car in a 60 mile per hour collision is fairly safe as long as there is no solid object in his way. His speed rolls him over and over along the ground, burning off some skin, but probably not breaking any bones unless he crashes into something."

Perry takes no chances on being hurt if he is asked to crash an automobile into another at high speed and have his car turn over and catch fire. He wires the doors closed and installs a springy steering wheel that will give if his body hits it. He drains the acid out of the battery, puts only a pint of gas in the tank, leaves the gas tank cap off, and straps himself in with a safety belt. An instant before the crash he flips off the ignition switch. He turns the car over by releasing the front end of a metal bar attached to one side of the frame. The rod digs into the ground and turns the car over neatly. When the collision occurs, fire starts automatically in a pile of gasoline-soaked rags hidden in the car. Contact with the other car completes a circuit that sets off a spark in the rags. Instead of a fire extinguisher to use in emergency, Perry carries a big cloth furniture pad, soaked with water, on the seat beside him.

With all these precautions he is perfectly safe if the crash goes according to schedule, and even if the unexpected happens he won't be badly hurt. He recalls the time when another stunt man and he were asked to drive a roadster at high speed off the side of a hill. Instead of staying on its four wheels as it went downhill, the car shot out into space, lit on its radiator, and rolled end over end. Neither man was hurt because their safety belts held them tightly in place. When the picture of the crash was run off at slow speed the stunt men saw that Perry's passenger opened the door on his side while the car was in the air, reached for his safety belt catch, and then decided that it was safer to stay with the car. He slammed the door shut again. It was all done in a couple of seconds, showing how fast a stunt man must think.

A good stunt man keeps his mind some six feet in front of him, so to speak, and this helps him do the right thing at the right time. And he has to be smart. Take

the time Perry had the job of jumping from the top of a 110-foot ocean cliff down into the surf. There was only four feet of water below him except when a big breaker was rolling in. If Perry could land in a breaker he would be able to make a shallow dive; otherwise four feet of water wouldn't help much. He took the risk out of the stunt by tossing a rock off the cliff and timing its fall. Then he knew just how much head start he had to give himself to hit the water as a breaker arrived.

It took brains to figure out a safe way to perform another act that had already maimed one stunt man. The picture called for an automobile collision at the edge of a cliff and one car was to hurtle off into space, the driver saving himself at the last second by reaching up and catching the limb of a sturdy tree that was growing out over the brink of the fall.

Perry had the stunt reduced to a mathematical basis, he thought, but he missed one important detail. "Everything went off like clockwork," he recalls: "I crashed into the other car and skidded off the cliff. I had removed the cushion from the driver's seat of the roadster and was kneeling behind the wheel so when the car shot past the tree it was easy for me to reach up and grab the limb and hang on. I dangled there while the car wrecked itself below and then I remembered what I had forgotten. There was no escape from the tree and I had to hang on until the crew could get a rope out to me and I could use it to get back to solid ground."

String Cutter From Bottle Opener



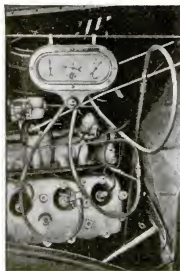
If a bottle opener of the type shown is sharpened at the point indicated, it makes a good string cutter. The sharpened edge being of a circular shape, it is easy to slip under a tight string on a package, and almost its entire circumference is protected or shielded by surrounding metal.



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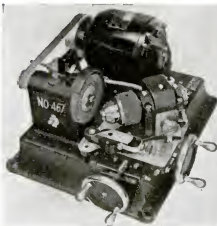


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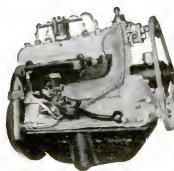


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Carrying the Torch for Industry

(Continued from page 75)

coastal waters. The frame of a 200-inch telescope was welded. Station KDKA in Pittsburgh was given an electric arc-welded antenna 718 feet high. Germany built an all-welded 10,000-ton pocket battleship.

Items like this attracted public attention from time to time, but it was not until the present industrial emergency came that the nation began to realize that the strong right arm of production held a torch.

Today, warships are very largely welding jobs, as are merchant hulls and entire barges and tugs. In fact, practically all of the vessels under 300 feet in length now in production in the United States are welded. There is a saving in weight, time and cost up to 15 percent, according to welding authorities, depending upon conditions.

The same is true of stationary and marine boilers and tanks used in oil refineries and chemical plants, as well as those used for water and other liquid storage.

Spot welding of airplane parts, such as wings and fuselages and gas welding of high-tensile plane tubings is common, yet it is a comparatively recent development.

Tanks, gun mounts, recoil mechanisms, anti-aircraft gun carriages, gasoline and oil trucks, tractor parts, railroad freight and passenger cars, electric locomotives, automobile frames, giant shovels, hoists and derricks, refrigerators, and even articulated, streamline trains form just a short, suggestive list of familiar products of the welding arc and blowpipe.

Among the more novel applications is the welding of entire bridge floors. Another is the welding of piles. Preparing the foundation of a large mid-western factory building, a foundation company drove 8,600 steel piles into the earth. As each 30-foot section of the 18-inch square, 1/2-inch thick pipe was driven into the earth, another section was hoisted into position and arc-welded onto it, until the pipes penetrated more than 100 feet. Then 12-inch H-beams 108 feet long were driven into them and concrete was poured.

Increased use of welding has resulted in improvement and improvement has brought about increased use, until the expert welder of the first world war would find himself a novice today unless he had

(Continued on page 168)

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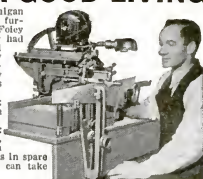
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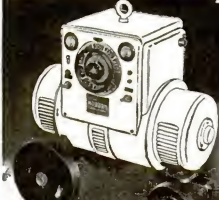
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modernized his technique. Aside from arc welding with covered electrodes and oxy-acetylene welding with high-temperature flame, some of the newer developments are: spot and line welding in which an electrical resistance is set up at special points to bind two sheets of metal together; atomic hydrogen welding, for high quality work; thermit welding in which iron oxide and aluminum are set off with a magnesium ribbon creating a flowing liquid alloy; brazing, which uses such alloys as phosphor-copper and silver-copper for fine jobs on thin metals, and the union-melt electric process which gives remarkable speed with no flash, glare or smoke.

Mechanized welding is giving efficiency to line production by the use of semi-automatic controls.

Flame-cutting, used during the first world war principally to reduce scrap, has now become a precise art and is rapidly edging aside shearing and forging. Steel three feet thick can be flame-cut by blowpipes with an accuracy of about 1/1000th of an inch and this renders possible cutting of plates prior to fabrication on such jobs as shipbuilding or tank making.

A novel use is for cutting the teethlike, interlocking expansion joints used on most modern bridges. The blowpipe is also valuable in wrinkle-bending of pipe, one side of which can be softened so the pipe can be shaped on the spot before being laid. Hard facing of metals by applying super hard alloys, such as stellite, flame hardening of a small section of a large piece of metal and flame cleaning of the surface of castings is a modern development. Stack cutting in which a number of layers of metal can be sliced through at a time and pattern devices which make the cutting process semi-automatic are increasing the value of the oxygen-using blowpipe.

The gouging process removes a narrow strip of metal from steel plate, forgings and casting. The descaling process "washes" away surface defects from slabs and billets. The descaling process removes scale from metal surfaces. The oxygen lance makes short work of very heavy cuts when aided by the oxy-acetylene blowpipe.

So the torch of industry, whether it joins together by welding, or puts asunder, by flame-cutting, is becoming a more complicated device as it becomes more refined.

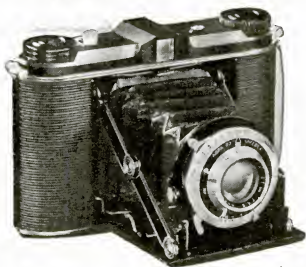
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I Flew Faster Than a Bullet

(Continued from page 53)

lost all sense of gravity; I was slipping through the air as slick as a hot knife through butter.

A glance at the instruments showed that my almost vertical descent had wound up the air speed needle on the instrument panels. It was past 500. Knowing that 40 miles per hour would be added on the pull-out, I started leveling off, pulling out at 7,500 feet.

Wham! That felt like a kick from a mule, but it was only the arresting of my speed. The Airacobra took the pullout without a tremor, slitting through the sky and showing an indicated air speed of 523 miles per hour on the instrument panels. My altitude at level was now 5,000 feet.

"Dive completed," I radioed the ground station. Returning to base."

I landed the little silver bullet and stepped from the cockpit. An examining physician gave me a minute going over, just in case, but pronounced me in tip-top shape except for an exhausted feeling. No two ways about it, testing is a strain on any pilot. After such dives some pilots develop a condition comparable to the "bends" that affect divers working under water.

The Airacobra "doctors" made their examination and turned in their report. No evidence of skin wrinkles or other symptoms of strain. Technicians removed the movie film and ran their calculations on the airspeed readings, temperature and pressure indications. Then came the amazing news that my plane had flown at a faster speed than any ever recorded: 620 miles per hour, the engineers calculated, allowing for all customary corrections that are used in figuring speed in this type of test.

Most fast aircraft must be "flown" all the time; but in such a ship as the P-39 the pilot is fortunate to have a craft which responds so easily to his wishes and has so many safety devices built into its structure. For instance, if the pilot should ever have to bail out of an Airacobra he would find the problem very simple. On both sides of him are doors similar to those in an automobile. If he has any doubts about his ability to open either of the cabin doors because of the tremendous wind action all he needs do is pull a latch which knocks the

door off its hinges and the door automatically falls away from the plane.

This is most important because the slipstream of air around the airplane at high speeds is almost like a solid brick wall. At 475 m.p.h., for example, the slipstream is the same consistency as water, and at 500 m.p.h. it is as though you were being pulled under water at 120 miles an hour. This problem has given England's R. A. F. some concern. It is impossible to bail out of some fighter airplanes unless they are turned over on their back. In this position once his cockpit cover has been pushed back the pilot merely releases his seat belt and tumbles earthward from his cockpit. Because it is not always possible to turn the plane upside down, particularly during times of emergency, when bailing out is required, the door features of the Airacobra are especially appreciated.

All pursuit ships and dive bombers must be tested to determine terminal velocity, namely; the speed at which the ship—at its particular weight—will fall.

When your ship is building up to terminal velocity you are actually falling free with the craft. No object which is loose in the cockpit has any weight, in the accepted sense, because it is falling at about the same speed as the plane. For example, in a dive I have seen a fire extinguisher break loose from its hanger and "float" around the cockpit until I lifted it out of the air and tucked it under my leg.

The only thing certain about plane speed records is their impermanence. For example, only a few years ago students of aerodynamics believed a speed of 400 miles per hour would set up a vibration so destructive it would whip a plane to pieces. But a plane was built and a test pilot flew it to demonstrate that theories do not always stand up.

Today many experts are saying that when a plane reaches 720 miles per hour, the speed of sound, the center of lift will shift forward to the leading edge of the wing, collapsing that supporting structure. This theory will be put to actual test sooner than we think, because new, faster planes are now on the drafting boards of our airplane factories.

☞ See index, page 4-A, to find where to buy articles described in this magazine. Say you saw it in Popular Mechanics.

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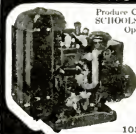
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All-American Sport

(Continued from page 43)

might be well to describe briefly how it is played. Further along there'll be tips from topnotch players on how to improve your game, if you are a devotee.

Softball differs from baseball most noticeably in these respects:

1. Base distances are 60 feet apart instead of 90, speeding up the game greatly.

2. The ball is larger and not quite so firm, although hard enough to bash in a perfectly good nose. Boy and girl teams play with an 11 3/4-inch ball, instead of the standard one 12 inches in circumference. In diameter, however, the latter is only half an inch larger than a baseball.

3. Softball bats are smaller in length and thickness. They have safety grips of cork, tape or other adhesive materials to lessen danger of being flung at the much closer fieldmen. Only the catcher and first baseman are allowed webs between the fingers of their mitts. With a fielder's glove, lacing is permitted between thumb and forefinger only.

4. Players may be ten in number instead of nine. The extra man is known as a "short fielder."

5. Seven innings are played.

6. Softball's style of pitching is underhanded because the box is only 43 feet from home plate. Even this short distance away, however, the ball has time to take a devastating "hook" because of its larger area in friction with the atmosphere. Good pitchers get a disconcerting "rise" effect by letting the ball slide off the palm's heel, thus imparting backspin similar to that of a crisp niblick shot in golf.

7. Because of the shortened base lines, the ball must leave the pitcher's hand before the runner may attempt a "steal."

There are said to be 1,500 softball parks in the country. The average cost is \$3,000 and seating capacity about 4,000. Admission charges run from a dime to 35 cents. The same scientific night lighting that made baseball practical after dark brought softball within reach of urban thousands, and aside from numerous twilight leagues, most adult softball in cities is played at night. It is the most popular after-work diversion for millions.

Nearly every factory, department store and big business institution has employe

teams. Briggs Body Works in Michigan has 100 inter-departmental teams playing softball. Aircraft manufacturers like Douglas, Lockheed, North American and Consolidated boast dozens of teams.

Because all American boys grew up with baseball they know, almost by instinct, how to play the game. However, here are a few hints that may be helpful in softball.

At the finish of his underhanded throw, a good pitcher finds his right hand high above his head or fully extended before him. Follow-through is one of the most important things he can do. It gives control and added speed to the ball.

Catchers throwing to second base should use the pitcher for a line marker, lining the ball 18 inches over his head. In a play at home plate tag the runner on his foot, which is the first part of him to get there.

The first baseman should hold out his glove as a target for fielders. It should be held shoulder high and never above the head, which invites an over-throw.

Second basemen should get to the bag at the crack of the bat for a double play and in balance for the quick snap to first.

The quick throw to first is a third baseman's biggest asset. Often it must be snapped when off balance.

Shortstops are the most versatile infielders. The best ones decide what they intend to do if the ball comes their way, even before the pitcher's throw.

An outfielder's first duty is to get the ball back pronto. Make every catch above the belt if possible, as you can line it up with your eye better. Make the catch with your left foot forward if you can. That puts you in position for the quickest possible throw.

In batting, don't grip too tight. It will spoil your timing. Don't hit from a position of the bat resting on your shoulder. Never get off-balance at the plate. Follow through to get both direction and distance.

Finally, in softball, as in any other game, be a good sport. Take victory as gracefully as a defeat. Don't beef at decisions against your team. The umpire makes mistakes sometimes but they will average up over seven innings. Don't fling down your glove at a misplay or throw your bat after a strike-out. It is childish to show temper. Don't let anything that happens spoil your game, for softball can be a lot of fun.

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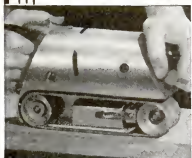
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Jump Out—the Air Is Fine!

(Continued from page 37)

People told him he was crazy, that the scientists agreed a man lost consciousness as he fell. Smith laughed, for as a circus aerialist he had fallen without losing consciousness. Finding muslin and other experimental materials too heavy he turned to silk and devised a means of packing the 'chute so a flyer could sit on it or lean against it comfortably.

Nothing came of his invention until the terrific mortality among pilots during the World War set army officers to thinking. When General William Mitchell, who commanded the American air force in France, inquired who knew about parachutes, Smith was given his opportunity to develop his invention at McCook Field.

For months Smith and an assistant, Guy Ball, sewed parachutes and dropped them from a plane, with lead dummies attached. Smith was about ready to make the first jump when a youth of 22, Leslie L. Irvin, arrived at the field April 28, 1919, with orders to make the first "live" jump with Smith's new 'chute. Smith piloted the plane. The crowd which gathered was sure Irvin was committing suicide, but he was as confident as Smith, though in his excitement Irvin didn't remember to watch himself in landing and broke his ankle. Irvin, too, lived to become a leading parachute manufacturer.

Soon, the parachute proved its worth under dramatic circumstances. One October day in 1922, Lieut Harold Harris was flying 2,500 feet above McCook Field when a wing buckled. He jumped, counted five and pulled what he thought was the ripcord. Nothing happened. Again he tugged frantically, then discovered he had been pulling on a leg strap. Harris fell more than 2,200 feet before he located the ripcord. At an altitude of less than 300 feet, his 'chute suddenly snapped open and landed him without injury. He had made the first chronicled emergency jump with a ripcord, manually operated 'chute. He had made the first delayed-opening jump of 2,200 feet and had become the first member of the Caterpillar Club.

From then on, many false theories were disproven. Capt. A. W. Stevens showed that a parachute would function from great heights by bailing out at 26,500 feet, and

James Floyd Smith made a pull-off jump at 100 feet. James Russell dived head foremost from 200 feet, his 'chute landing him without difficulty. Spud Manning dove from more than two and a half miles up and didn't pull his ripcord until near the ground.

The parachute was achieving a reputation for reliability. "In fact," points out Ronald Colwell, a veteran of 521 jumps, now in the Army Air Corps, "accidents are caused by carelessness, and the good jumpers die in bed." In an 11-year study of parachute jumping Colwell has found no physical reactions other than temporary loss of hearing. Nor is there a feeling of dizziness, but rather of suspension, without the slightest sensation of falling until near the earth.

"The greatest danger in 'chute jumping," Colwell says, "is steerage of the parachute by slipping—closing the canopy by pulling on the shroud lines. One might pull them too far, and if that happens at a very low altitude, the chute will collapse and plummet to earth." He warns that unless one is familiar with the operation and function of parachutes, he should not under any circumstances attempt a delayed opening at any time. This should be left to professionals, while others forced to take to aerial life preservers should pull their ripcords after counting up to five.

Capt. Harry G. Armstrong of the Army Air Corps, fell nearly a thousand feet before pulling his ripcord and noted that his mind was "rapid, precise, penetrating and clear." Strangely enough, the irritating effects of the wind, which smarted his eyes when he sat in the cockpit without goggles, disappeared when he jumped and his vision was perfectly clear. Like Colwell, he became physically conscious of the fact that he was falling only when he could clearly see the ground, at about 1,900 feet. Before he jumped he could distinguish the sound of the motors of several planes but during his fall he was momentarily deaf. He felt no rush of air until near the ground, when there was a gently increasing sensation of air pressure, as if he were sinking into a feather bed.

Names and addresses listed in the index, page 4-A, show where to buy manufactured products described in this magazine. Say you saw it in Popular Mechanics.



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(Continued from Colorado Section)

far back as 1925 this metal has become recognized as a good substitute for tungsten in tool steels and as an alloying element in structural steels. Since 1925 its use in carbon and alloy steels has increased.

Dr. M. A. Grossman, director of research, Carnegie-Illinois Steel Corporation, points out that back of the strenuous role which steel plays in present day equipment is a vastly greater knowledge of each step in manufacture than was available years ago. Too, control of every operation is more precise, resulting in a superior product. Both of these have resulted from research conducted for the most part on peacetime uses of steel. Three of the most important studies now in progress are those on toughness, heat treatment and grain size of steel. Toughness in high-strength steels is extremely important in the war machine and weapon, as well as to the automobile and farm implement makers, to railroads and to many other users. Research men have found that the shape of the structural member has an influence on its toughness and have developed tests to study this effect. The extent to which a steel is hardened by heat treatment is termed its hardenability. More fundamental is the research being done on grain size. The metallurgists have discovered that the grain size of steel may be altered by various treatments and that certain desirable qualities may be achieved in this manner. Rolling steel in the cold state is one means of producing a finer grained, more workable steel than that which is produced by other processes.

Steel men assert that the art of steel making has been revolutionized since the early twenties. New products have been developed; the quality of others has been radically improved so that they are now actually new materials, although called by the same names. These improvements in the finished steel product have required basic changes in steel making, starting with the raw materials and moving steadily through the making of pig iron, steel ingots and each step of the finishing process. The quality of steel now produced in the open-hearth furnaces is a far superior product, definitely suited to the ever-changing and more exacting process. Blast

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furnaces now produce a better pig iron by scientific grading and mixing of the ores and where necessary the crushing and sizing of the ores, coke and limestone that go into the pig-iron-making process. The open-hearth plant has become a process laboratory where the steel made is now produced scientifically by slag control, temperature control and control of the ingredients going into the steel. Uniform qualities of steel and uniform heat and other treatments required through fabrication of the finished article is facilitated by being able to secure steel in which the grain structure is controlled. As evidence of the improvement in basic steel properties, building codes today permit the use of a 20,000-pound per square inch stress, where two to four years ago it was 18,000 pounds and previously 16,000. Automobile fenders may now be pressed with as much as 18 inches of crown, where 20 years ago two or three inches was the maximum.

In a related field, the heat treating of small manufactured parts, Westinghouse engineers have developed a gas which is regarded as the solution to one of the major problems in heat treating—the hardening of steels without softening or scaling at the surface. The gas, called Endogas, is used as a protective atmosphere for furnaces and it is now at work in all the major airplane engine and accessory plants turning out thousands of parts such as shafts, gears and bolts. Not only does Endogas counteract destructive gases that soften steel surfaces in heat treating, but it also saves time and money because it eliminates the necessity of machining steel parts after they have been hardened.

Other companies have developed combinations of gases or methods for use in scale-free heat treatment.

Rapid strides in the science of steel making have had, and will continue to have a profound effect not only upon the manner in which modern warfare is waged, but also upon the national economy. They have made possible the development of natural resources, the newer progress of transportation, the better preparation and preservation of foods, more economical construction of modern plant and office buildings, better roads, better agricultural buildings, improved modern airplane construction and have made contributions in innumerable other fields.

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Trailer-Blazing in Africa

(Continued from page 71)

men brought to Europe. Yet it's the same animal as the Samotherium that lived in Europe fifteen million years ago. It belongs to the family of the giraffidae, and like a giraffe it has atrophied vocal cords and horns detached from the skull, held by the skin. It has the neck of a horse, the body of an antelope, the legs of a zebra, bovine tail and hoofs, a tongue as long as an anteater's, eyes rolling like a chameleon's. To top it all, it has four stomachs.

That humming ahead of us is the Mam-buti village. Grand little guys, these pygmies. Toughened by life in this world which for us is an inferno, made tireless by long game tracking, fearless by dangers they face every moment of their existence, they are shy with strangers, but faithful to the friend, kind, happy and gallant.

A shrill cry. Our approach has been discovered. A deadly silence. They wonder who is coming, are ready to disappear in flight.

"Ea-yo-ho-oo-ho!"

They recognize me by this cry.

"Aa, baaba, yambo baaba yangu!" they shout. "Here thou art, oh father. Welcome our father!"

Three days of march, behind untiring legs of the pygmies and each of us has left a dozen pounds of weight on the trail. A wide river teeming with crocodiles bars our path. Pygmies climb like monkeys up high trees, let down a long liana; one of them swings at the end of it, just over scores of snapping jaws, until he succeeds in grabbing a branch on the other side. Then all of them swarm up trees and along the liana, weaving coils of vines until a bridge takes form, high in the air, and rough stairs are built for us.

Up we go to a dizzy height. Steady now. Let's not look down at those twenty-foot crocs. Let's not look ahead at this precarious contraption swinging at every step.

Safe on the other shore, we rest while the pygmies explore okapi tracks and prepare their traps—holes three feet by ten, eight feet deep, covered with sticks and leaves.

Four days later Tumbako, as we call him from the way he asks for tobacco, runs in. During the night an okapi, a big male,

K 1429

has fallen into a trap. Now we must build a palisade around the hole strong enough to resist the terrific thrusts of the animal once we have lifted him out. Then we will have to coax him into the cage other pygmies are already building. Then, inch by inch, the machetes will have to cut a path through the jungle.

Carry a cumbersome cage like that, with a ton of kicking, lunging okapi inside it? What did you say? Take off the bottom and let the animal carry his own weight on his own legs?

That's an idea! It works beautifully, too. The okapi is reluctant, the cage pushes him. He wants to run away, the cage stops him. We can travel as fast as the pygmies open the path.

We are a bit late facing the buffaloes, but there has never been an expedition which wasn't behind schedule. Next month we'll not only deal with the buffaloes, but also with a certain nine-foot leopard, some elephants and lions, and meet the Giant Princess of Rwanda.

Until then, "Salamu, Bwana!"

(Concluded next month)

Crepe Paper Tints Photo Prints

Photographs can be tinted almost any color with crepe paper and water. Place a strip of the colored paper in a tray of water and let it soak until the water is about the desired shade. Immerse the print in the colored water and allow it to remain about 10 minutes. Then wash and dry in the usual manner.

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Code Practice Oscillator

(Continued from page 135)

tapped universal variety is mounted directly on the speaker. In operation, with the volume control turned full on, a clear note should be heard when the key is depressed. In case oscillations do not occur, it is only necessary to reverse the polarity of the audio transformer. To do this, shift the brown speaker lead from the blue primary lead clip to the red; and the long connecting wire from red to blue on primary.

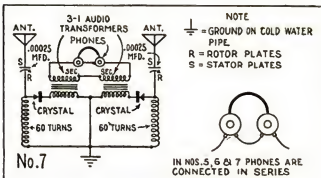
Note—Remove jumper wire between common positive and —10 in Fig. 1 of Tuning-Eye Set Tester, May issue, page 134A.

Seven Crystal Sets for Beginners

(Continued from page 138)

broadcast set. If a 365 or 370 mmfd. condenser is used, add 10 or more turns to coil.

All of the remaining experimental circuits except No. 3 employ coils wound with



No. 22 d.c.c. magnet wire on 2½-in. diameter cardboard or bakelite tubing, the length of the tubing depending on the number of turns specified. Transformers shown are regular audio types and the crystals are of the fixed variety. No. 2 is the simplest type; tuning is done by shifting a clip tap on bared turns on the coil to point where loudest signal is heard. No. 3 calls for two variable resistors (rheostats) connected in series. No. 4 is a common variety that is fairly selective; both coils are wound on the same tubing. Nos. 5, 6 and 7 make use of two crystals. These circuits are more or less experimental but will step up the signal strength. No. 6 employs a push-pull input audio transformer with center-tapped primary. No. 7 uses two transformers. With all crystal sets use a ground on a cold water pipe and make the antenna as long and high as possible.

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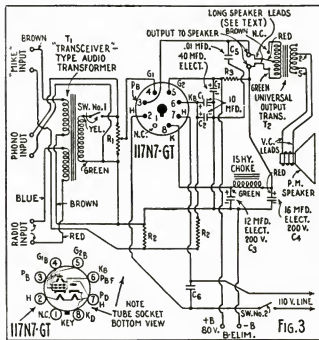
Calculator Machine Co., (Mfr.) DEPT. 119, P.O. BOX 1111, CHICAGO, ILL.

Four-Purpose Amplifier Unit

(Continued from page 137)

the circuit when phono pickup is used. Transformer (T₁) is Thordarson T72A59 type used in building short-wave transceivers and has both a radio input winding and a microphone winding. This transformer is on top of the baseboard, as will be noted in photos B and C.

The (T₂) universal speaker matching transformer is required for this type of speaker to match its voice coil to the 3,000-



ohm tube load. These transformers come with instructions for connecting, however be sure that the one you purchase is rated for the same ohmage as the speaker coil. A detailed list of the original parts used is available from Popular Mechanics radio department without charge.

To test the amplifier, first connect the audio source to the correct input terminals. For example if the set is to be used with a small receiver, connect the headphone terminals of the receiver to the binding posts on the unit marked "radio input." The set will tune exactly as before, the amplifier merely increases the volume. If hum is noticeable, reverse the power plug in the wall socket. Always keep the amplifier some distance from the receiver. The B-eliminator leads can be as long as 10 feet. When used with microphone keep volume control turned down to eliminate feedback. Leads to the loud speaker may be 30 feet when used as a call system. The blueprint number for this article is R-292.

L183

Have You Idle Horses?

(Continued from page 59)

cially to the sharp shoulders where the block and head are joined by the head gasket. In some cases the surfaces of the combustion chambers have been chrome-plated to give them the smooth surfaces desired.

A dirty water jacket also aggravates pre-ignition. When engine heat is retained in the block instead of being carried to the radiator the motor runs hotter than it should. Clean the water system out by reverse-flow flushing and from then on use a rust inhibitor in the radiator.

If your car is a 1936 model or earlier you can increase its power and miles per gallon by stepping up the compression ratio. This wasn't advisable when such cars were new but since then the anti-knock characteristics of gasolines have been increased and you might as well take advantage of today's better fuels.

Things to do for increased mileage on the road include: go through gears at reasonably low speeds, avoid fast accelerations and excessively high speeds, maintain reasonably constant highway speeds, and keep idling time at a minimum.

Model-Airplane Propellers Tested For Balance With Jig



Propellers for flying airplane models can be tested for balance with the aid of this stand. It consists of two vertical pieces nailed to a base block. In use, a piece of music wire is passed through the propeller hub and then laid across the ends of the two uprights of the jig. If the propeller is balanced, it will remain in any position that it is placed.

—Ray J. Marran, Kansas City, Mo.

Flower vases always should be washed thoroughly with soap and hot water when withered blossoms are being discarded, otherwise bacteria, which decay the stems of flowers, survive in the vase.

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The Battle of Beams

(Continued from page 85)

mess of lies, insinuations, fakes and jibes which characterizes the battle of beams.

American stations pretty closely follow the standards set by the General Electric programs which avoid out-and-out propaganda and are heavy on education and entertainment.

Controversies are avoided and from Schenectady to Europe, in English and French, and to South America in Spanish and Portuguese go spot news, music which leans toward the symphonic, scientific talks, educational programs, interviews, market quotations, translations of speeches by important personages, sports, Hollywood chats, travel talks, English lessons, children's programs, mailbags for explorers and rebroadcasts of network programs. Similar programs go to Mexico and western South America and to Asia and Australia from KGEI in San Francisco. This station also conducts a mailbag program through which friends communicate with missionaries all over the world.

The daily reward comes in hundreds of letters of thanks. During bombing raids, when their own stations are silent, an Englishman writes that American short-wave programs entertain groups huddled in the shelters. A trader in Colombia tells of placing a loud speaker in the village plaza and furnishing music for a dance. An oil man writes of news bulletins received in the jungles of the Dutch East Indies.

A letter to KGEI from an American newspaper man, after a tour of the Far East, sums it up: "People I've talked to, even in India, appreciate the news service, the music and entertainment. It's hard to explain how much American programs mean to these people, cut off from the rest of the world, with censorship rampant. The most important thing is unbiased American news."

From these stations that are raising their voices for America, the national anthem will float proudly on the air to the furthest corners of the world as soon as Uncle Sam gets his electronic sleeves rolled up. And it won't be long now.

See index, page 4-A, to find where to buy articles described in this magazine. Say you saw it in Popular Mechanics.



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The Search for Substitutes

(Continued from page 3)

ing of zinc. One Ford research expert says:

"In some cases we already have made changes in materials. The new parts, far from being inferior to the old, are in many cases distinctly better. The appearance of some parts also has been improved, notably where plastics have been introduced to conserve metal."

The saving on nickel is achieved by using straight chromium steel instead of nickel-chromium steel on all bright metal trim; chromium-molybdenum steel instead of nickel bearing steel for transmission and differential gears, and heavier copper plate and higher polish on copper base for nickel plating, to reduce thickness of nickel necessary for protection.

Aluminum will be conserved by making eight out of 10 tractor parts of iron or other ferrous material instead of aluminum; using steel and plastic gears instead of aluminum timing gears; replacing aluminum cylinder heads with cast iron; substituting die-cast or powdered-iron moldings for aluminum in brake wheel pistons; and replacing aluminum valve-chamber covers and distributor bodies with cast iron.

Zinc savings result from replacing die-cast trimmings used on the exterior with steel stampings; substituting steel stampings or malleable castings for zinc die-cast steering post hub band brackets; using a plastic panel instead of an instrument panel grille requiring $2\frac{3}{4}$ pounds of zinc; changing zinc horn button to plastic and interior metal trim from zinc to plastic or bright finished steel; replacing brass radiator shells with copper and using glass reflectors for the rear of sealed beam headlamps instead of silver-plated brass. The saving on zinc in these operations is estimated at about 6,000 tons per year.

Magnesium already has been replaced by Ford in the manufacture of tractor parts, the only ones now made of this lightweight metal being salvaged from old tractors. Savings on other defense materials, including tin, tungsten and cork, are being studied by Ford. The design department is working toward a reduction in the number of body joints requiring solder (tin). Molybdenum alloys are being developed to replace tungsten for hard tips on tools and a cardboard substitute for cork is under consideration.

In other automotive plants, savings on aluminum may be achieved by substituting steel or cast-iron pistons for aluminum pistons. Ford changed to steel pistons several years ago and Chevrolet, Pontiac and Crosley cars are now equipped with cast-iron pistons. The entire industry has agreed to curtail new-car production about one-fifth beginning August 1, this year. Indications are that 1942 models will be produced, but that there will be no 1943 models, the previous year's styles being continued.

A group of scientists specializing in metallurgy has been organized by the Office of Production Management at Washington to study methods of saving or developing substitutes for defense metals. Aluminum and magnesium are two minerals on which primary attention will be directed, while other studies will include:

Possibilities of conserving or providing substitutes for tin in cans, collapsible tubes, babbitt and solder; substituting molybdenum or other metals for tungsten in making high-speed tool steel, lamp filaments, electrical contacts and in many phases of the chemical industry; provision of substitutes for flake graphite, now used in making graphite crucibles and retorts for nonferrous work, graphite crucibles for iron and steel and graphite stoppers for steel ladles and extension of the usage of beryllium, which is employed in various alloys for hardness and strength.

The telephone industry has developed means of conserving aluminum, nickel and zinc, and to some extent magnesium. Steel, instead of aluminum dial wheels are being used on new telephones and phones equipped with less nickel and zinc are being tried out.

Synthetic rubber and copper are being tried out as substitutes for such uses as aluminum in refrigerator ice trays. Synthetic rubber is being substituted for natural rubber, which must be imported, in scores of articles, including linings of bulletproof gasoline tanks for airplanes, acid-resisting linings for tanks, hose for gasoline and oil and many other things, even tires. In many cases, the synthetic rubber is superior to natural rubber. The principal handicap is the lack of production fa-

(Continued to page 188)

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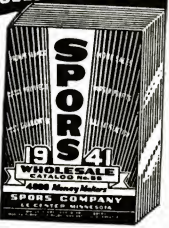
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(Continued from page 186)

cilities, a problem being solved to some extent by the erection of new plants and enlargement of old.

Nylon, a synthetic fiber, already is known to the public, especially women, as a good substitute for silk, of which almost all must be imported. The use of nylon instead of silk in parachutes has been the subject of extensive study.

Just recently the Westinghouse Electric and Manufacturing Company announced the development of a new magnetic steel which is expected to help conserve America's supplies of steel and copper. Used in transformers, the new product will permit savings of high-grade steel alloy and copper amounting to more than 5,000 tons per year. The amount of copper saved would make brass jackets for 400 million 30-caliber shells for army rifles. The brass used in these shells is about 90 percent copper. The magnetic steel, called Hipersil, makes it possible to build transformers that weigh less than those made of the materials employed heretofore. Thus, less copper wire is required than in the old type and the new transformers permit less drop in voltage when a demand for power is made upon them. It is voltage drop that often causes dimming and flickering of house lights.

The hunt for "ersatz" is removing the shiny "tinfoil," made mostly from aluminum foil, from our chewing gum, candy bars and cigarettes, but in its place will be a wrapping material "just as good," at least good enough in the emergency.

At first glance, it appears that Mr. and Mrs. America will experience little or no inconvenience from this temporary period of substitutes.

Razor Blade Used as Eraser Guide

When typing at home and there is no eraser guide at hand, a safety-razor blade of the type shown can be used. Before using the blade, the sharp edges should be dulled with a file or on a grinding wheel.



—William Swallow, Brooklyn, N. Y.

Guarding Our Vital Industries

(Continued from page 30)

tives as well as Federal Bureau of Identification operatives whose identities are unknown even to the police staff.

If you apply for a job in the plant, you are first photographed and fingerprinted and then you wait ten days while your statements and background are checked. Once on the payroll, you wear a badge that restricts you from every part of the plant except the area in which you work. At irregular intervals the contents of all lunch boxes and other packages carried by employees are inspected.

No outsider can enter the plant unless he has an appointment with an official inside and he can't get through the entrance until his appointment is confirmed. Only American citizens can enter under any circumstances and no visitor can wander around at will. If his appointment is in the engineering department he must undergo a second scrutiny and sign a pass book upon entering and leaving.

No one except special employees who have sworn to observe particular secrecy is permitted in the restricted parts of the plant where confidential work is being done. Even those who are working on a secret project can't gain admittance to the restricted area until they have shown their special credentials to a guard. Then the guard opens a barred entrance door by remote control.

Fire is one of the most dangerous weapons of the saboteur and at Douglas extraordinary precautions are taken against it. Each working shift has a fire chief who has given special training to hundreds of the men in his shift. Fire equipment that includes carbon dioxide tanks and asbestos suits is scattered through the plant and the company maintains a large modern fire rig that is also suitable as a crash wagon for handling accidents at the airport.

Every one of the smart tricks employed by professional arsonists has been studied and prepared for. The fact is that fires, most often caused by carelessness, are more prevalent during times of re-armament simply because of the rush of work, and this is one of the reasons for taking elaborate precautions against fires.

The Santa Monica plant and the other

(Continued to page 190)



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DESIGNED BY EXPERTS FOR AMATEUR HOME BUILDERS

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For championship engine performance, maximum economy and dependability on your vacation tour, make sure your spark plugs are Champions—the spark plugs champions use!

WHETHER YOUR VACATION tour takes you to northern lakes and streams or "down Mexico way", your car will perform better if your spark plugs are dependable and in first-class condition.

So to be sure of carefree motoring have your spark plugs tested before setting out on your vacation tour. If they are worn out, of inferior quality, show leakage under pressure, or have been in service in excess of 10,000 miles, have a set of new Champions installed. They will soon pay for themselves in gas saved, renewed power, speed and better all around engine performance.



The Sillment seal outstanding among Champion's patented features, eliminates troublesome leakage common to ordinary spark plugs. Leaky spark plugs overheat, causing pre-ignition and rough, unresponsive engine operation. Insist on Champions—the spark plugs champions use.

You're always ahead with Champion!

Douglas divisions are being augmented by a new \$12,000,000 aircraft factory at Long Beach in which, in addition to the present kinds of protection, camouflage that will hide it from air observers is being provided. Even if an enemy bombing crew knew the factory's location it would have trouble picking out the buildings and if the plant should be bombed the damage would be held to a minimum because of the scattered arrangement of the buildings. Already close to completion, the decentralized factory will consist of 12 buildings so placed over 200 acres that each building is separate from the others.

The plant will be virtually invisible at night, both from the ground and the sky, owing to its landscaping and the fact that light traps and filters will prevent light leaks. Even the entrance to a railroad freight terminal in one of the buildings will be protected by giant double light-proof doors. The factory will be self-contained as far as power and gas are concerned, independent of outside sources.

The lessons in protection that are being learned at Douglas and at the other aircraft factories are being applied rapidly in automobile plants, steel mills, and even in petroleum refineries. In every industry connected with the re-armament program the workers are being cautioned to report every action or circumstance that seems in any way suspicious. Even though only one in a hundred such tips may lead to uncovering an actual case of attempted sabotage, constant vigilance of employees may save their lives and jobs. This is one of the most important factors in making America's defense both spy and sabotage-proof.

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Hex	1/2"	3/8"	5/16"
Thread	3/8"-24	1/4"-32	1/4"-32
Thread Length	7/32	3/32	5/32
Weight, Grams	8	3 1/2	2 1/2

CHAMPION

SPARK PLUG CO.

900 Upton Ave.

Toledo • Ohio

Man-o'-War With Wings

(Continued from page 11)

gases have been provided for heating the living spaces, and provision has been made for an electric stove in the galley. On an extended flight the crew may spend three days in the air. Life rafts as well as parachutes in racks are carried.

Although its basic design would be suitable for a commodious 75-passenger air liner the B-19 has a strictly military interior. A gunner occupies the tip of the nose with a bombardier at his sighting instruments below and behind the gun station. The pilot and co-pilot sit side by side in the main control cabin, some 30 feet forward of the leading edge of the wing. Behind them sit the navigator and commander at their desks and behind these men are the radio operator and chief engineer. The radio system includes as much equipment as a medium-sized broadcasting station.

The mechanics' quarters are aft of the main control cabin and from their compartment the mechanics can enter the wing, walking along electrically-lighted passageways to the engine nacelles. Ordinary adjustments and minor repairs can be made during flight. The main engines drive the instrument air pumps, the big hydraulic pumps, and the de-icer pumps, as well as turning the flight propellers.

Aft of the mechanics' compartment are the auxiliary engines, refueling valves, oxygen supply, and other gear, and aft of this department is the big bomb bay. Toward the tail of the fuselage, reached by a passageway, are a wardroom and sleeping compartment, the galley and the rear gunner's compartment in the tail.

Both the main control cabin and the sleeping compartment are soundproofed and heated. An oxygen system leads to all stations on the ship and portable oxygen equipment also is provided.

The wing tips of the B-19 are almost 16 feet above the ground. An ordinary boarding gangway would be impractical, so you climb a stair ladder that drops down from a hatchway in the bottom of the hull.

Construction of the bomber began in a seven-story 110-ton steel jig that held the wing and center section of the fuselage in a vertical position. The nose section was built separately and the rear end of the fuselage and tail group as a third unit.



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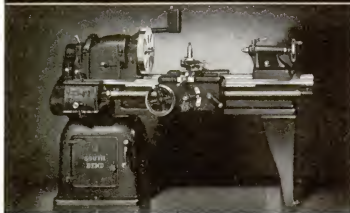
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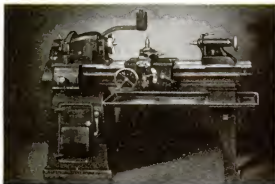
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Consider the work to be done, then choose the size and type of lathe that will give you the most efficient service. Remember that versatility and precision are important in a tool room lathe. For manufacturing operations, a lathe must also have plenty of power, speed, stamina.

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Consult our Engineering Department about the lathe best suited to your work. We do no special tooling and make no special machines, but we will gladly give you our recommendation. A copy of our new Catalog No. 100A describing all sizes and types of South Bend Lathes will be sent on request.

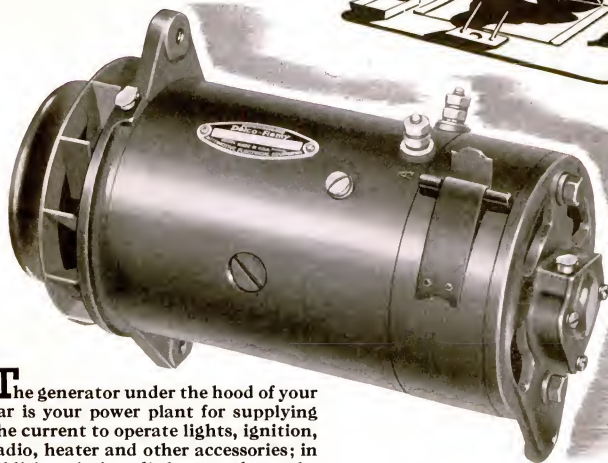
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And Camels give you less
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"THAT CAMEL FLAVOR is some-
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give you a cooler, more flavorful smoke
... and *less nicotine* (see above).

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